Presented at 1st International Workshop of Life-logging for Pervasive Health (LLPH 2013), Venice, Italy, 5th May 2013

Lifestyle stories: Correlating User Information using a Story-Inspired Paradigm

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ABSTRACT
The *lifestyle management* area has become increasingly important during the past years due to an individual and societal need for increasing self-awareness. Technologies are the core of this area as they can support humans in reflecting over what happened through capturing, interpreting, correlating and visualizing various aspects of their lives. For this, we created an interactive context-aware experience platform that can bring together lifestyle-related information. Given that close involvement of end users in such systems, information presentation plays a central role. We present here our *story-inspired framework* that we used to transform sensed information into abstract multimedia objects. This framework allows for dynamic and adaptive creation of concise information correlations, for personalisation and sharing. This paper presents the design framework and realization of the story-inspired paradigm and the user experiments performed in order to explore and advance various aspects of the framework.

Categories and Subject Descriptors
H.1.2. [**User/Machine Systems**]: Human factors, Human information processing; H.5.2 [**User Interfaces**]; I.2.4 [**Knowledge Representation Formalisms and Methods**].

General Terms
Design, Human Factors.

Keywords
Context-aware systems, story-inspired information presentation, self-reflection, self-understanding.

1. INTRODUCTION
The *lifestyle management* area has become increasingly important during the past years due to present as well as expected burden on healthcare systems posed by people living longer and with various chronic conditions [5]. Lifestyles are complex and evolving, therefore when we build systems aimed at this area it is not enough to only focus on certain aspects of users' lives. Instead, we need to take a more holistic and long-term view of what is important and try to capture as many aspects of people's lives as possible [25]. By doing this we can better support users in self-awareness, self-understanding, self-reflection and, ultimately, self-change [9]. With these aims in mind we created *a context-aware lifestyle management system*, called MyRoR (a play on *mirror*), able to provide a more comprehensive picture of a user's daily life in order to ***support*** end users in identifying not only *what* happened during the day but also in providing objective clues related to *why* it might have happened. One of the main goals of the MyRoR platform is to provide end users with access to their information so that they can remember and understand what happened and reflect over why it happened. For that, it is important that the system provides easy-to-understand interfaces that allow for accessing the available information at both abstract and detailed level. It is important to emphasise this aspect as it made it necessary to focus our work on issues around *information presentation and visualisation*.

Given the large variety of information recorded, we found that using only the currently available means, such as graphs, charts or maps, is very challenging both for system designers and end users. In our quest to find more engaging paradigms for representing information either for individual use or for sharing, we turned to ***stories***, not only as visualisation means but also as complex structures for organizing information along various dimensions. The stories we created are multimedia-based representations of interpreted user information organised as *collections of meaningful events* (see [1]). Within the MyRoR stories, the available and relevant user information is processed (i.e., filtered, abstracted, correlated) and then mapped to various types of media, such as images, icons or text. The story-based paradigm is very powerful as it allows for dynamic changes, personalisation through inclusion of user-generated content, easy sharing, and quick and fun overview of recorded data. Various challenges are involved in creating the stories and they could be summarised through these two main aspects: (1) creating a dynamic and adaptive automatic process able to decide what information is meaningful enough to be included within a certain user story, how to obtain it and how to present it to end users; (2) enabling users to customize their stories for various purposes such as esthetical reasons, exploring various aspects of available information or sharing. For addressing these challenges, our research focused on designing a model-based story creation framework capable of capturing the variety of aspects involved in creating such interfaces. Various methods were employed to address these aspects, ranging from finding inspiration in existing literature and systems to performing two types of exploratory user-based experiments aimed at creating more understanding into various issues related to building the experience platform, the story model, the automatic story creation process and the visual stories. This paper presents the related work that inspired us (Section 2), the story-inspired design and realization framework we created (Section 3) as well as the exploratory user-based experiments we performed in order to test and extend this framework and the main findings derived from the experiments (Section 4). We conclude by discussing how such findings impacted the initial story-based

Pervasive Health'10, May 5-8, 2013, Venice, Italy.

design and the role such systems can play in future healthcare scenarios (Section 5).

2. RELATED WORK

Humans need to socially connect and share their experiences, as Maslow [12] and Shneiderman [23] noted and, over time, they have used stories to do so, as argued for by Bruner [2] and Brooks [1]. In [2] Bruner describes a story as formed by a sequence of events that are meaningful enough to be told as they contain a certain breach of normality. In [1] Brooks defines a story as "*any general or abstract description of a meaningful collection of events, people, and/or things, which denotes a causal or temporal linkage among them*". Works such as [10][21] show that narratives are an important vehicle for reflecting and rationalising our experiences and emotions.

A comprehensive survey of computer-based story creation methods is included in [15]. The methods are categorized as: *rule-based*, where events are brought together based on pre-defined logic rules taking into account current event status and historical factual information; *state-transition based*, where events are defined as states specifying the current situation and are put together using, e.g., Bayesian networks or finite state machines; *goal-based*, where the story is constructed to fit a certain final goal; *template-based*, where events are selected to fit a certain template; *script-based*, where stories are created based on a script written in a high level language; *semantic inference based*, where stories are created based on a network of semantically organized events; *emergent narrative based*, where users can create their own stories based on their social interactions inside a play; and *narrative function based* where narrative principles are enforced on the overall story and event sequence.

In [20] the authors present a model used for adapting a mixed reality game based on user's location: the game tells a different story based on where the main character (a detective) goes. In [7] stories are created by putting pictures together along a physical path (based on location annotations). In [26], the authors present a multi-media digital-physical scrapbook system for memory sharing, as well as for supporting user studies performed with elderly people. Relevant work in the area of merging storytelling concepts with life logging systems is described in [4]. The systems considered are focused on image collection, based on using Microsoft's SenseCam system. We found ourselves most inspired by works such as the Affective Diary [24] and AffectAura [13], where user information centred on emotions, was recorded, abstracted and shown to the users in a more user friendly way involving emotion-informed shapes and colours.

For visualizing the MyRoR stories, we were most inspired by the Scratch environment (http://scratch.mit.edu) with its flexible, customizable, multimedia-based paradigm. Other environments considered were Alice (http://www.alice.org) and Greenfoot (http://www.greenfoot.org).

While there is a growing community of software for lifestyle management (such as http://personalinformatics.org/), most used means for representing information are primarily graph-based. While these means provide a high detail (we also use them in our system for that purpose) they are very hard to use or even understand when considering a platform that aims to bring together a large number of very diverse information. So far, we could not find many other systems that use story-based concepts for self-monitoring systems as in this work.

3. STORY CREATION FRAMEWORK

Stories are very interesting information abstraction and correlation structures and present many challenges in terms of selecting and prioritizing information as well as allowing for dynamic changes based on user preferences, purpose or theme. In this section we present the design framework employed for creating the MyRoR stories, starting with a summarized and categorized description of the information that can be gathered by the MyRoR platform.

3.1 Modeling stories

For lifestyle solutions, it is important to create a system that can be used for collecting a variety of information types within realistic scenarios with a minimal effort required from the end user. For most of us, daily activities alternate static with mobile settings, work with play, quiet with noisy, calm with stress. Works such as [3, 6, 9, 11, 18, 25] provide useful insight into various aspects of our daily lives as well as factors that affect them. In order to address real-life scenarios and capture as many aspects as possible of our lifestyles without the need for intrusive sensors, we decided to focus on three categories of sources: (1) wearable sensors; (2) mobile phones; and (3) desktop/laptop machines. The context information that the MyRoR platform can provide (either as recorded or after processing) is presented in Figure 1.

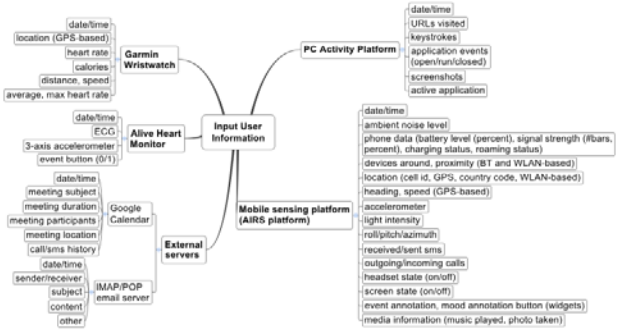

Figure 1 Information in MyRoR

This information is further processed and categorized around eight types of contexts[1,2]: (1) *Activity context* includes information about what the user was doing as well as various measures of activity intensity; (2) *Availability context* includes information regarding user's availability as well the availability of resources necessary to the user in certain situations; (3) *Emotional context* includes information about user's emotional state. Such information can be obtained through various means, from physiological sensing to pattern analysis (e.g., keywords, activities, etc.). The emotional context plays an important role in in self-reflection [19, 22]; (4) *Environmental context* includes information about environment parameters, especially the ones that are perceived as having an impact on wellbeing, such as ambient noise, weather information, light intensity levels, pollen levels, and others; (5*) Mental context* refers to information about user's interests both in terms of topic (i.e., what the user was interested in) as well as intensity level (i.e., how interested was a user in a certain topic); (6) *Social context* includes information about user's social activities, both physical (i.e., face-to-face) and virtual (i.e., online). Social communication is an important human dimension [12, 23] and it plays an important role in wellbeing [27]; (7) *Spatial context* includes location information (absolute or relative) at various granularity levels as well as

[1] For a more detailed description of the information available in MyRoR and how such contexts are derived see [17][16].
[2] We define context as in [6].

derived information such as distance or heading; (8) *Temporal context* contains time-related information such as timestamps or duration. Every input source records timestamps together with the actual input data. Temporal information is essential for creating the envisioned correlations.

We now describe at the relation between the stories and the various types of context described above. Following [1, 2], a story includes: (1) *Setting:* defined by parameters such as time, place; (2) *Theme*: emphasizes one or more types of contexts (e.g., focuses on physical movements or on physiological changes); (3) *Characters*: the entities that take part in the story (humans or other living beings), have various roles and are connected by certain relationships; (4) *Storyline*: formed by a sequence of *meaningful events*, where an *event* can be described in terms of the *context types* defined above; (5) *Point of view*: determines how the story is told based on the intended audience (consumer). More details about the relation between the story events and the context types are provided in the next section. A model of the concepts as well as the relationships between the story elements and the various information, context and media objects is provided in Figure 2.

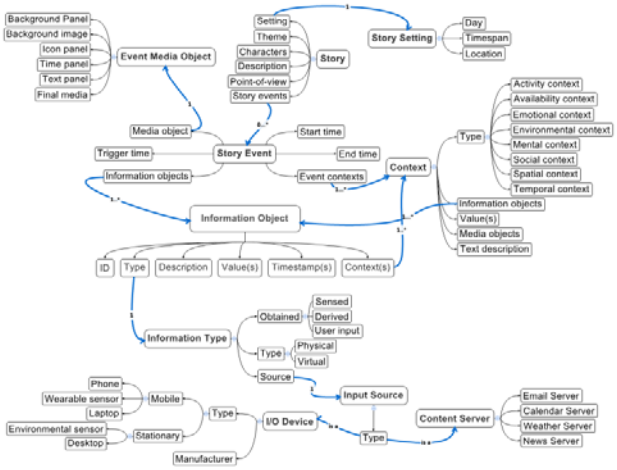

Figure 2 Information model

3.2 Automatic story creation

Similar to any system that involves collecting and processing a large amount of data one important challenge is to identify what is *meaningful* enough to be included within a story. We considered various methods to create story events, from end-user driven to fully automatic. In the end, we decided on a mixed approach, based both on user annotations of most interesting events (see more details on annotations in Section 4) as well as on system-based reasoning (i.e., identifying certain significant changes or *event triggers*). The user annotations as well as the various triggers detected within the data available are used for determining the significant time points into the recordings and for creating the story events by adding a time range around that point (e.g., +/- 5 minutes)[3].

In Figure 3 we include a model of how the MyRoR stories are created. We define a story as a set $S = \{E_S, C_S, O_S, G\}$, where $E_S = \{E_1, \dots, E_n\}$ is the set of story events, C_S the set of story contexts (one set per event), O_S the set of information objects (one set per event) and G the story setting. For each event (defined by a start and end time), the system checks for all available information in the database as well as from the external sources (e.g., email server, calendar server, etc.), forming the set of event-specific information objects O_S. Based on the information objects found, values for each context type are computed for each event (c_j for each C_i). For each context type there can be one or more values v_k, depending on how many information objects are used as well as on how many types of processing algorithms there are.

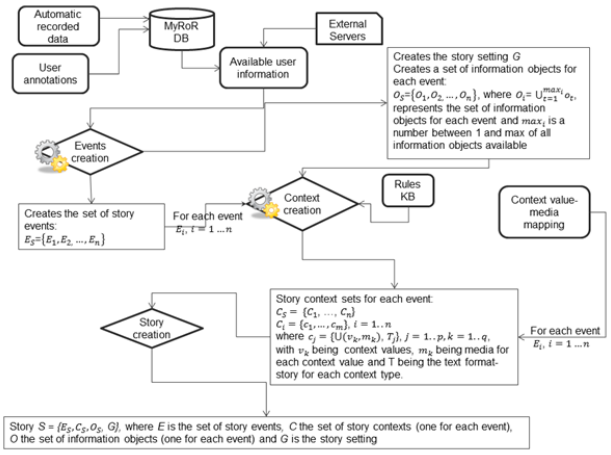

Figure 3 Story creation process

Media objects m_k are then added to each context type, based on mapping between context values and various types of media. A text version of the story is created for each story event. The final story (S) is created by merging information for each event $E_i, i = 1..n$. Information processing is an essential part of such systems and it starts from the moment the data is collected from the local storages.

As described in [16], the recorded data comes in various formats and it needs to be transformed in order to be stored into the database. Further processing and correlation has to be done in order to make such data meaningful for end users.

We use various sets of rules in order to derive higher-level knowledge from the available user information. Figure 4 presents an overview of how and where rules are used. Four major reasoning points are depicted: (1) Determining the story events; (2) Determining the context types for each story event based on the available information objects; (3) Determining the values for each context type: this might involve various means for processing values of information objects, such as interpreting certain values or correlating certain data (e.g., deriving typing frequency based on number of characters per minute); (4) Mapping numeric values to semantic labels (e.g., dB value for sound level mapped onto a possible type of environment, etc.); (5) Mapping semantic labels onto media.

The information processing rules contain various algorithms necessary for deriving new knowledge from available input information. Depending on the type of information, the algorithms involve: (1) Averaging over the duration of the event (e.g., heart rate, movement, etc.); (2) Finding last available value (i.e., when no change happened during the event but there exists information recorded before the event- e.g., last recorded location); (3) Correlating certain information with time in order to derive frequency (e.g., typing speed, number of times the end user turned on the phone screen, number of sms received, etc.).

[3] We need to create a time interval in order to capture information that might be used to explain the meaningfulness of the event, in terms of causes as well as effects.

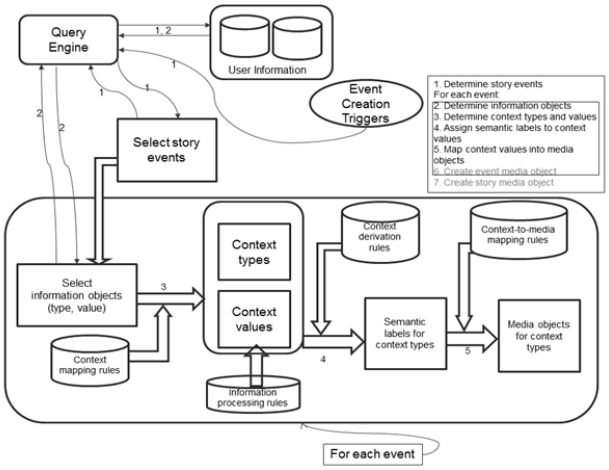

Figure 4 Rule-based information processing

All the reasoning points require existing knowledge for how to derive new higher-level concepts, which can be provided at design time, by the end user or through learning. An important element is the Event Creation Triggers, which is the abstraction for the knowledge needed to decide how to create the meaningful events that will be included in the story. An example of the resulting multi-media object for a story event is included in Figure 5. The main elements are: (1) *Time panel*: shows the time when the event trigger happened (mid-event); (2) *Icon panel*: contains the icon representations of event's context values; (3) *Text panel*: contains a text description of the event's context values; (4) *Background panel*: shows an image that creates a setting for the event, based on a certain selection algorithm[4]; (5) *Main panel*: combines all panels into one final event media object. The multiple panels involved in creating a story event allow for emphasizing certain aspects therefore assigning various levels of importance to information.

Figure 5 Example of a story event media object

As it is hard to imagine a system that might manage to collect all relevant information, it is important that users are an integral part of such solutions, being an examiner, explainer, producer and consumer of processed data. Allowing end users access to certain unprocessed or lightly processed data can generate abstractions that a system designer might not have considered or could not even consider due to incomplete information. The focus in our work is less on automatic reasoning based on a fixed data model and more on allowing the model to incorporate human level concepts that are incomplete and ever-changing. Another important requirement is that the system can evolve by being able to add/remove input sources, processing algorithms and even presentation models.

[4] Not included here because of space reasons.

4. USER-BASED EXPERIMENTS

Our work in creating the story-inspired design and realization framework had two main components: theoretical and empirical. While our explorations of concepts, models as well as existing system evaluations provided us with the background to create the initial system and story concept, the user-based explorations allowed us to gather further insights and requirements that allowed us to advance both the design as well as the implementation[5]. Within this exploratory framework, *our main aim became to understand what people find more interesting during the day, how that changes from day to day and from person to person and how to organize and visualize such information*. The process had two main components: (1) an online questionnaire focused on aspects that did not require hands-on experience with the system but could benefit from being able to reach a larger audience, such as looking into participants' self-reflective behaviors in relation to the attitudes towards the MyRor system and our story-based interface; (2) hands-on usage of the system followed by a two-phased semi-structured interview round meant to explore aspects around creating, interacting with and experiencing stories. Due to space limitations, we only focus here on the hands-on experiments. Details and results of the online questionnaire can be found in [17]. However, it is important to mention that 83.3% of the people (38 participants) that said they would find a system like MyRoR useful for self-reflection said they would like to have a story-based interface available[6] and that 95% of the ones that said they liked the system and the story said they would like to be able to customize their stories in aspects such as characters, places, emotional states, or activities.

4.1 Recording setup and interviews

For the hands-on experiments, we decided to focus on a smaller number of participants (6) and in-depth interviews that would allow exploring the various aspects involved in the research questions. The participants were unpaid volunteers with a certain interest in self-monitoring, although previous experience with such systems was not a requirement. Table 1 presents data on the 6 participants.

Table 1 Participants information

User ID/Age range/Gender	Recording duration/period	Follow-up Interview and duration
U1/40-45/Male	Since 04/2011	Part 1: 04/2011, 80 min. Part 2: 03/2012, 35 min
U2/80-85/Male	2 days, 04/ 2011	Part 1: 04/2011, 74 min Part 2: 05/2012, 50 min
U3/25-30/Male	4 days, 04/ 2011	Part 1: 04/2011, 50 min Part 2: 12/2011, 30 min
U4/35-40/Female	4 days, 05/ 2011	Part 1: 05/2012, 58 min Part 2: 01/2012, 20 min
U5/35-40/Male	4 days, 08/ 2011	Part 1: 08/2011, 54 min Part 2: 12/2011, 12 min
U6/35-40/Female	6 days in 08/2011, 6 days in 04/2012	Part 1: 08/2011, 55 min Part 2: 04/2012, 110 min (over 2 days)

[5] Works such as [8] argue for using an the reasons of using exploratory approach in information visualisation work.

[6] We used a concept movie where story events looked similar to the one shown in Figure 5.

Each participant had to use the system for recording own data. The recording setting was an important step in the experiments. Based on discussions with initial participants, we decided that it would be better not to focus on a certain recording scenario but instead allow each participant to decide what, when and for how long they would like to record, making it more realistic. Some people were interested in recording over specific days, such as days with more meetings or days with an expected higher stress level (such as starting a new job). Some people only recorded for a few hours over one day, others mainly during work hours, others tried to combine both work and weekend days to compare their physiological and social settings. The user information was automatically gathered through: (1) a wearable device capable to provide physiological data (we chose the Alive monitor from Alive Technologies for various reasons, including the availability of an annotation button); (2) a mobile phone running the sensing platform (initially Symbian-based, later Android-based[7]); (3) a Windows-based activity platform running on one or more of participant's computers. On demand information was available through external servers, such as Google Calendar and an IMAP-based email server. The users were instructed to use the provided means to annotate what they considered most interesting during the recording days. Initially, such annotations were provided through the event button on the Alive monitor (Figure 6). Later, based on participants' feedback and given the technological advances, two phone widgets were added, helping users to give meaning to their annotations as well as record their mood. After the recording, user's data was collected onto user's machine and examined during the follow-up interviews through the various visualization and access means available in MyRoR (see [17] for more detail).

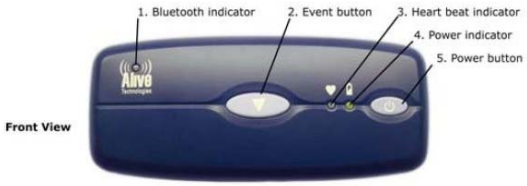

Figure 6 The Alive Heart and Activity Monitor

The interviews took place over two phases. The first one usually took place within a week after the recording session and focused on the importance of information and on what was considered interesting during the recording period. The second interview took place once the automatic story creation was implemented and focused primarily on how users experienced the stories also testing how well the story captured relevant information capable to help the participant remember what happened during the recording. The interviews followed a semi-structured format, which allowed for a more relaxed atmosphere and for flexibility in discussions while still following a pre-defined set of topics. The main topics covered were around: (1) meaningfulness of the annotated events; (2) usefulness of information gathered; (3) usefulness of information correlations we provided both as part of visualization as well as part of the story creation process; (4) using story-based visualizations for correlating and visualizing information; (5) sharing aspects (either for stories or for any other information); (6) other system usage issues.

In order to extract information on the issues listed above, we used various probing means, such as: (**M1**) Using the annotations and annotating process to reflect and create narratives on the importance of daily events and information; (**M2**) Using the MyRoR-provided data visualizations to discuss the importance of recorded information, test its role in remembering and reflection and discuss new correlations; (**M3**) Using the story-based concept and prototype to collect information on creating, experiencing and sharing stories. The feedback received during Phase 1 of the interviews was used to improve the system (both at the design and implementation level) and finally create the framework and scripts for automatically generating such stories (as described in Section 3.2). In the Phase 2 of the interviews, each participant could see their own personalized stories, representing own data. In some cases, the participants decided to perform new recordings, in order to provide richer background data for their stories and take advantage of the new added features, such as phone-based text and mood annotations. The continuous interplay between explaining annotations, looking at visualizations of recorded data, and discussing stories encouraged detailed discussions around what happened during their days, focused on stimulating memories and self-reflection on meaning and relevance of data. In order to allow for a more natural discussion, the interviews were digitally recorded and later transcribed. The results extracted through the experiments and the follow up interviews were coded and categorized along 4 main themes, as shown in Figure 7.

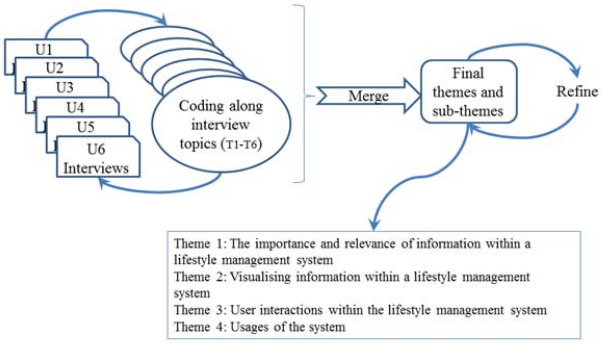

Figure 7 Creating the main themes

We next include an extract from the findings, with an emphasis on the ones related to the story-based information presentation.

4.2 Main findings and their impact on design

Importance of information

In terms of what information is more interesting to be captured and presented both in the system and through the stories, the interviews showed that the *usefulness of information cannot be detached from the context it was recorded in*. For example, within a meeting, important information includes stress levels, participants, ambient noise levels, or room temperature. Within a travel scenario, location becomes more important, together with, e.g., crowd levels, noise and stress levels. The importance of information can also change based on the varying nature of the same event: i.e., meeting as a gathering of many people (e.g., workshop) vs. meeting as a dedicated, short brainstorming. Furthermore, as U4 noted, what people find important not only depends on the situation they are in but also on what is going on in their lives, such as certain (chronic or acute) health condition(s) or current goals that take precedence (e.g., heart problems, losing weight, quitting smoking, etc.).

Certain information, such as heart rate or movement, was more interesting in the Phase 1 interviews than in Phase 2, when additional information was needed in order to contextualize it.

[7] In 2011, the NORS platform used initially was ported to Android and became AIRS.

During the interviews, the movement information (based on energy expenditure derived from Alive monitor's accelerometer data), provided more value for remembering and creating narratives than heart rate data. Having an approximate measure of movement, as MET (Metabolic Equivalent of Task) values provide, as well as a meaningful description of what they could represent (e.g., as provided in [14]) seemed to be very helpful to allow people to identify and remember their activities.

Emails and calendar events proved more valuable in longer-term recollection, especially as means to contextualize the recorded data. The call/messaging history is an important component of daily social activities and very useful to have within a story (they were used as event triggers). The keystrokes are able to provide very interesting information mainly when interpreted and correlated with other information, such as time, applications used, or additional knowledge such as emotion-related words (e.g., "sad", "happy"). Similarly, application usage and web activity are very useful as stress indicators when combined with user-specific information, such as increased usage of certain applications (e.g., task managers) or patterns (e.g., using a certain app/website when tired or stressed). Other useful correlations identified were: frequency of typing (number of keystrokes/min), frequency of using Backspace (as a measure of stress), the number of Bluetooth devices around vs. the time they were around (e.g., useful to figure out when people came and left during a meeting or if they were just passing by).

Experiencing stories

When presented with their daily stories, all participants liked the story-based visualization as a way of having a compressed alternative to the detailed visualizations provided by MyRoR (e.g., graph, map and word cloud based). More specifically, U2 said he liked more to see the story interface as it was easier to understand and it brought all the information together. He compared the system with his current means of recording health-related information and could see the advantages provided by the system as it allowed him to create a relation between his heart rate and other things happening within the same time. He said he would like to use the system as a digital diary to keep track of his health, especially as he can add his own notes to it. U5 believed he would get more information out of playing a short story (no longer than 5 minutes), than looking through the graph-based visualizations of his data, which he considered they required too much effort and that he would probably not use them at all. Similarly, U1 believed that in most situations he would just look at his daily story and use the detailed visualizations less and less. U4 liked the story as a collection of various types of media as, she said, "pictures say more than words". She said that watching your story is like watching a snapshot of what you were as a person at a certain moment in time; that it gives you an outsider view and makes you reflect on your behavior. She was impressed by how much data could be compressed within a few icons and text lines. U3 liked the story representation but considered that he would not necessarily look at it every day. However, he thought it would be a good way to share experiences within a social circle and that he would like to see such stories shared by his friends. U6 was very excited to see her personalized story. She very much enjoyed how her familiar locations (emphasized through the background panel), her data and her annotations were helping to create a compact picture of what happened during the recording days.

Creating and customizing stories

While initially used just as a way to identify what users considered interesting during recordings, annotations eventually became an important part of the stories, being used in creating story events (see Section 3.2). The interesting aspect was that once the free-text annotations (available through the AIRS phone widgets) started to be used by users, the stories became even more interesting as they included an added level of personalization. U6 and U1 said that they would like their annotations to be shown more prominently within their stories (e.g., even as part of the background, as U6 suggested), as they are their most personalized information. The fact that they spent effort in putting them in made them somehow more valuable than the automatically recorded information. The annotating process was also influenced by understanding how stories were created (e.g., that each event has a 10-minute window of recorded data), what was recorded and how information could be accessed through the system. Both U1 and U6 noticed that when using the text annotations, they tried to focus on what was harder to be captured by the system. All users said they would like their stories (i.e., story events) to be created through a mixture of their annotations and system intelligence.

The story concept evolved in time to include suggestions from the participants. Most significantly, the text version was included based on suggestions from U5. Having a text version is also helpful when no icons are available to map certain context values. U6 said that she read the text version because 'it was there' but, once she would get used to the icons, she would prefer to just take a quick glance at them instead. U2 liked both the icon-based and the text version of the story. Surprisingly, he could very well follow and read the text description, even though he is poorly sighted. However, U1 was not entirely convinced he liked having the text version of the story and said he might want to be able to switch it off if he chooses to.

Besides gathering reactions to experiencing stories, it was also important for us to understand if and how the participants would like such stories to be customized, both in terms of the graphical interface and in terms of the information shown. While all participants said that they would like their story to feel personal, by being able to have their own icons, pictures and so on, they also said they would not like to spend too much time on such process. Therefore, some fast way of customization would need to be provided, such as initial configuration through templates or skins, allowing for selecting pre-defined sets of icons. One interesting comment was made by U4 regarding being able to select an own avatar (as in the initial concept): she said she would like such option so she could capture how she saw herself during a certain period in life, reflecting her beliefs, her fears and self-image. The background panel was an important element in customizing and personalizing a story and it was based on mapping recorded location (when available) to user-defined places (e.g., "home", "work") or areas (e.g., "Colchester area", "University of Essex").

Sharing stories

In terms of attitudes towards sharing, U1 did not see anything bad in sharing his stories as long as he is in control of how and what is shared. He thought that he would be especially interested in sharing stories within certain situations, such as travelling, in order to show aspects such as path during the day, how noisy the environment was, how his heart rate changed. U1 and U5 both talked about their interest in having the possibility to select parts of their stories to be shared based on situation and not necessarily based on what information should be shown. For example, U5 said that he would be perfectly ok in sharing his story showing

various types of information recorded while he was at a garden party, as the situation, not necessarily the type of data, defined what was acceptable to be shared. U1 said that, most of the times, he would prefer his shared stories to only include abstracted information, not detailed, such as how much he was typing as opposed to what he was typing, etc. However, he also saw the possibility of sharing detailed information, such as heart rate, movement, location and so on, if it served to make a certain point (i.e., that his heart rate was constantly higher than normal during the flight). This system usage as evidence was also mentioned by U5 after one incident where he had an argument with a bus driver that he took a different route than usual. U3 thought that the stories would be perfect to be shared within social networks. While he thought that his stories might be a bit boring, as he considered his days uneventful, he said he would really like to see his friends' stories. U4 was also interested in sharing her stories, especially if the system would allow for customizing them based on the intended purpose and audience, such as allowing her to create a different persona through stories.

5. EVOLVING THE STORY-BASED PARADIGM

Similar to the discussions around importance of information, all participants believed that their preferences regarding how their stories are created and shown would change with time, context, etc., therefore the system should accommodate such changes. U1 said that it would be good if he could tell the system what the 'primary' focus should be: e.g., seeing the emotional aspects, physical (movement-related), social (interaction-related) and so on. During this change of focus, the story should also adapt the correlated information (I call it 'secondary'), in order to show information that is relevant to the primary focus. U1 also proposed that one way to do such changes in primary and secondary focus could be through templates, as opposed to having the user select the information all the time. The topic of using templates to select what to be shown (or not) was explored during various interviews (especially with U1, U5 and U6) as a solution to customizing stories with a limited effort required from an end user. Based on these discussions, two kind of template-based story content customization were identified: (1) to set story focus; (2) to select the information types to be included within a story.

Participants were also asked what other information and correlations should be added to stories. U1, U3 and U6 said they would like to see more detailed social information included (such as names and pictures of people around). U6 said that she would like to see a location-based path as part of the story, both for indoor and outdoor activities. U5 said that he would like to see his stories being created around significant changes within his movements (e.g., through observing energy expenditure) and ambient noise levels. He also would like the story to be able to capture episodic events, the same way he sees his day: e.g., start/end of a bus journey. U6 said that she would like the system to be able to identify busy and stressful moments during the day.

While the current stories are day-based, U3, U4 and U6 mentioned that they would like their stories to evolve towards helping them identify certain patterns in their behavior based on multiple days information processing. U4 said she would like her story to be able to reflect patterns within correlations between certain physiological parameters and possible causes (e.g., "your heart goes up when…"). U3 said he would like to be able to query the system for 'similar' story events within a certain period, e.g., showing events representing 'smoking'.

An important goal of the user experiments was to understand how to evolve the story-based visualization. Figure 8 presents a concept of how such interface could evolve in order to include main findings from the user experiments.

Figure 8 Evolving the story-based interface

The concept incorporates various essential aspects: (1) providing means to control (i.e., move between events) and customize the story (i.e., changing focus, selecting what information should be shown, changing certain graphical elements of the story); (2) allowing users to annotate an event with their own descriptions through text, audio or video; (3) allowing users to share an event or a story (within this scenario, it could be that the end user decides to customize the event/story before sharing); (4) allowing users to explore the information provided in more detail: e.g., clicking the certain icons (e.g., heart rate, movement, noise, and location) will open a timeline view of that information; (5) providing a prioritized view of the information: user annotations are included in a more prominent window as they were seen as a more important type of information.

Through such extensions, the story-based interface could become the main interface to exploring the user information, allowing for both abstract and detailed views of information as well as various types of customizations. Such extensions to the existing system are part of the envisioned future work and further explorations need to be performed in order to capture all the details in terms of designing as well as experiencing such features.

More specifically for the healthcare area, we consider other ways to evolve the story-based paradigm to: (1) allow another party to create stories for an end user (e.g., allowing a GP to select information that they consider relevant to a patient's heart condition); (2) add persuasive goals into a story model when stories are used for helping monitoring certain health conditions. For example, if the goal is to make you move more, a story can clearly show how much you moved during the day instead of just showing that you moved. Even more, if desirable, suggestions as well as encouraging messages can be added to stories; (3) create specific stories to be shared within a community context, such as focusing on environmental conditions (e.g., noise levels, temperature, atmospheric pressure changes, etc.). Such stories can then become parts of bigger stories created based on contributions from various community members.

6. CONCLUSIONS

In this paper we focused on the story-based design framework at the center of our MyRoR experience platform for lifestyle management. In this, we use story-based structures for abstracting and correlating user context information. We also presented some of our exploratory user-based experiments aimed at better understanding how stories should be automatically created in

order to incorporate meaningful information and how they should be used for interacting with end users. Our experiments showed that stories, as lifestyle management solutions in general, have to adapt with situations, time and current health conditions. That means that we cannot create lifestyle management systems that only focus on a certain type of information. The importance of information changes constantly, as the user experiences different situations: sometimes heart rate is most interesting, sometimes physical location. In order to present relevant information to end users we need to be able to change the role of information in a dynamic way, therefore we need to create dynamic information and presentation models that can adapt based on changes in context. The multi-media story-based concept was seen by the participants as a very powerful way to encapsulate a vast and varied amount of information and to provide an engaging and personal way of allowing access to own recordings. The story-based concept allows for multiple ways of abstracting, personalizing, organizing, prioritizing and sharing information. Using a model-based process allows for experimenting with various ways of creating a story (e.g., over a day, over a time period, along a certain topic, over a situation, etc.).

7. ACKNOWLEDGMENTS

This work was funded by EPSRC through the PAL project, grant number TP/AN072C. We are very thankful to the people that gave their time and insight for the experiments and interviews. We would also like to thank Dirk Trossen for providing continuous support to this work through the AIRS platform development.

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