An Attempt to Merge Local and Technological Paradigms in the Digital Representation of Indigenous Knowledge

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ABSTRACT
Current technology trends and developments have hardly been informed by African indigenous and rural knowledge systems. Thus either substantial modifications are necessary in adapting technology to the requirements of indigenous knowledge systems or those systems are inadequately represented through technologies. This paper explores different options of organising video recorded indigenous knowledge in the pursuit of maintaining local communication patterns and practices. The evolutionary design of our indigenous knowledge management system is informed by a series of interactions and prototype evaluations with a pilot community in Eastern Namibia.

Keywords
Indigenous knowledge management system, rural, traditional, video

1. INTRODUCTION
Information and Communications Technology (ICT) applications developed in urban settings do not account for the challenges of African rural environments [5]. Oyugi, Dunckley & Smith [7] noted that people's concepts of knowledge and forms of information communication depend on their locality and so it is essential that they be able to shape their use of ICT without stepping outside of their culture and identity. However if technology was designed in the absence of an input from the local culture, its appropriation often fails [9]. Gruijters and Blake [4] affirm that the focus must be to satisfy the user's needs and map their actual experience into system architecture to be used for a development of a system. Thus for the design of an Indigenous Knowledge Management system we need to understand the role and structure of Indigenous Knowledge in the local context.

Indigenous Knowledge (IK) is local knowledge and an important aspect of life to the rural areas which is unique to a given culture, society or regional community. Indigenous knowledge is often considered less valuable than modern science in the context of development. Currently, the indigenous knowledge is only accessible through the holders of the knowledge as it is not written down, nor is it recorded in any electronic form. As elderly people and knowledgeable senior community members die, so does their knowledge, because indigenous knowledge is shared within the communities through oral and performed practices only. The knowledge, wisdom and experience, can add greatly beneficial development methods to the local communities. The indigenous forms of communication are important to local level decision making processes and for the preservation and spread of indigenous knowledge. However through migration to urban areas the chain of knowledge transfer has been disturbed with the risk of total loss of this indigenous knowledge. In Namibia, different from other countries, rural-urban migration is characterised by a strong maintenance of rural links. Namibian migrants keep on investing in their traditional rural areas while considering towns and cities to be their temporary domicile only [6]. However regularly returning community members struggle as they do not have the necessary skills or indigenous knowledge for survival or to perform certain actions that this knowledge requires or advises. At this point of time there is no technological supported platform where community members and migrants can continue to share locally relevant knowledge.

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2. PROJECT BACKGROUND
Since 2008 a long-term collaborative research project which aims to design and develop an indigenous knowledge management system with a selected local community has embarked in, as a proof of concept. The target users of the system are the community members, mostly the elders, who upload and organise videos and audios for the younger users in town to view and learn from. Over the years we have been continuously exploring alternative design methods and concepts with the community in an attempt to map local communication patterns into an appropriate ICT indigenous knowledge architecture [10].

2.1 Pilot Community's Set-Up
The pilot community engaged in the project is located in Eastern Namibia, in the Omaheke region, reachable via gravel and sand road. The village consists of 18 homesteads with a total of 200 rural dwellers ranging mostly of the Herero ethnic group from toddlers to the elderly. Some of the community members mostly the youth that are involved in the pilot migrate in and out of the

village to the urban areas for work or school going purposes; therefore they are not stationed at the village on a regular basis and are at times not involved in the project because of the above mentioned reason.

The elders and some of the youth have no secondary qualification and have been residing in the village since childhood. Some of the younger members attended school and left school early due to financial constraints. English proficiency is generally limited and therefore most communication takes place in their mother tongue, Herero. The design team includes voluntarily participating elders and youth from the community. The researchers and developers consist of students and staff from Namibia, South Africa, Germany, and Denmark. The first author of this paper originates from the pilot village and serves as the main interface between the external researchers and the community members to facilitate sessions and simultaneous translations.

In terms of ICT infrastructure and exposure there is a huge digital divide between urban and rural dwellers in Namibia. In the rural areas there is limited Internet connection and the usage of mobile phones is also limited because in some rural areas there is no satellite coverage, whereas in the urban areas there is access to Internet and mobile phone connections.

2.2 Video Capturing

The community elders possess valuable indigenous skills and knowledge, but most of it is not documented or physically preserved. We have initially captured a variety of local practices and stories in the form of video recordings. The videos were taken over a year over a number of field trips by the researchers and the community members [1].

The community members were equipped with flip cameras and sophisticated phones to record what they found worthwhile documenting. The videos were uploaded to the researcher's laptop and played back to the community members at selected occasions and following field trips. The videos are initially saved with a time stamp and high-level descriptive name which is meaningful only to the researchers.

2.3 Community Interactions

Being conscious of the differences in structuring, organising and transferring of indigenous knowledge an attempt is being made to model the knowledge architecture and features based on the actual communication practises of the community. For example, the elders determine how, when and with whom to share specific knowledge. Although the youngsters are hardly actively inquiring about the knowledge but are patiently absorbing as they listen. Thus a major distinction of the "narrator" role and the "listener" role in our system design has been distinguished.

In order to derive ideas on how to organize and represent the videos in a way which is meaningful and understood by the community members numerous community meetings, contextual interviews, prototype design and evaluation sessions were held [10]. In the initial meetings with the community members, discussions arose whereby the elders wanted to share their indigenous knowledge with others just like they would do in the natural way. Elders commented that a lot of the youth have gone to the urban area and when returning to the rural area they tend to struggle. Knowing that the community is well engaged in the project it was explored how knowledge amongst themselves was shared. Prototypes were developed and evaluated to test for suitability within the existing context, for further acceptance and feedback. Selected features of the prototypes were designed to map the way community members actually transfer knowledge. The workshops and prototype testing was done in the rural area with the community.

Due to their level of technological understanding, the community members didn't have specific ideas initially about how they could organize videos so that it is retrievable from the developed prototypes. On the other hand the developers from overseas never experienced the life of being in the rural areas and getting to see how the rural people perform different tasks. Thus developer community interactions are guided by principles of action research with a high emphasis on mutual learning [3].

3. VIDEO REPRESENTATIONS

A number of representations of videos were explored which would be intuitive and usable to the community members. In order to take sensitive design decisions a number of evaluation sessions were run with low and high fidelity prototypes. Also tagging, metadata and associative organisations have been investigated with the community members. Below the different options and conclusions made in regard to their suitability are described.

3.1 ITunes Organisation

As a most simplistic way to display a list of videos, ITunes were used. ITunes is an application that can represent video lists as thumbnails. In ITunes videos were displayed one after the other, whereby the users would select videos either by scrolling to the left or to the right. If a user wants to view a specific video, the user double clicks on the thumbnail. The process of sequential search seemed intuitive to the community members and they could not suggest any other way of organising the videos. From a developer's perspective major problems of retrieval could be anticipated as the number of videos would increase also in terms of selecting videos based on thumbnails only.

3.2 Thumbnail Sorting

To explore a more sophisticated way of categorising videos a thumbnail sorting session with the community was run [10]. Videos captured previously by the community, as well as unfamiliar videos from another research site were represented by means of cards with printed thumbnails. There were 60 cards based on different stories. The aim of the sorting was for the community members to place the cards on a board according to their association. Discussions arose as to why videos with similar images like goats were being placed together. The elders of the community would say that they belonged together. Related videos for example of plants should be grouped together so that when searching for videos about plants then they are all grouped together and the same would apply when searching for videos about milking. The participants had difficulty trying to figure out what the cards were and how the thumbnails related to the videos (which were taken weeks ago) even though significant scenes were chosen as thumbnails. Also all videos not taken in the village were discarded by the participants. The method yielded some design ideas like as to which videos are linked together yet no significant breakthrough in terms of overall knowledge architecture.

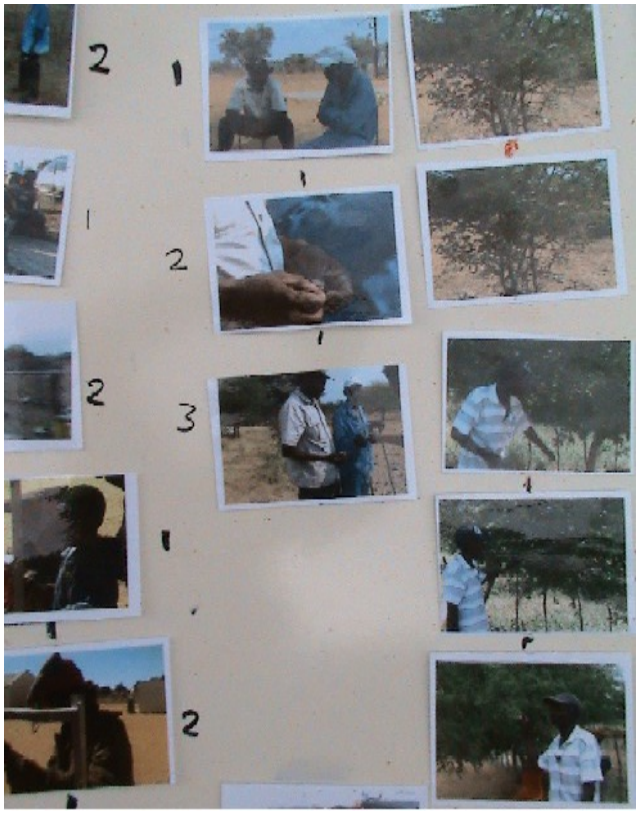

Figure 1: Thumbnail sorting (Kapuire et. al. 2010)

3.3 Metadata

During a community meeting it was agreed that it is important to note who recorded the video and where they are staying, as this would give the video credibility. It is also important who is on the video and who is the main speaker. Considering adding the name of the plant under discussion in a specific video is problematic due the phenomena of multiple context dependent terms given to the same object. For example, when a plant is small it has a name but when it grows it gets a different name, also depending on whether it is used for healing or eating (Bidwell et al. 2010). Moreover the same plants can be at different places. If a video is associated with a name of the plant or the place of origin, searching would be difficult to allocate the right video. As the retrieving of the right video would depend on how it was categorised during the organizing of the videos, it is anticipated that a number of challenges in the absence of a common category system would make it difficult to retrieve the right video.

While knowing that metadata is data that contains information about other data, it has shown that multimedia annotation is hard and requires effort from the users. During a prototype evaluation, the community members had to enter metadata (see Figure 2). The process was hard for them as they were not familiar to the process. Based on the usability of the developed prototypes, it will show the difficulties of using metadata as a concept to organise videos.

4. PROTOTYPES

A series of prototypes were developed with the aim of evaluating design ideas of organising the videos for appropriate retrieval by the community members.

4.1 Prototype 1

The prototype was developed remotely by students from Germany based on our written specification only. An application was developed which was then tested within and by the community. The prototype was developed based on concepts familiar to the programmers. This was the first attempt in representing the local videos within an application.

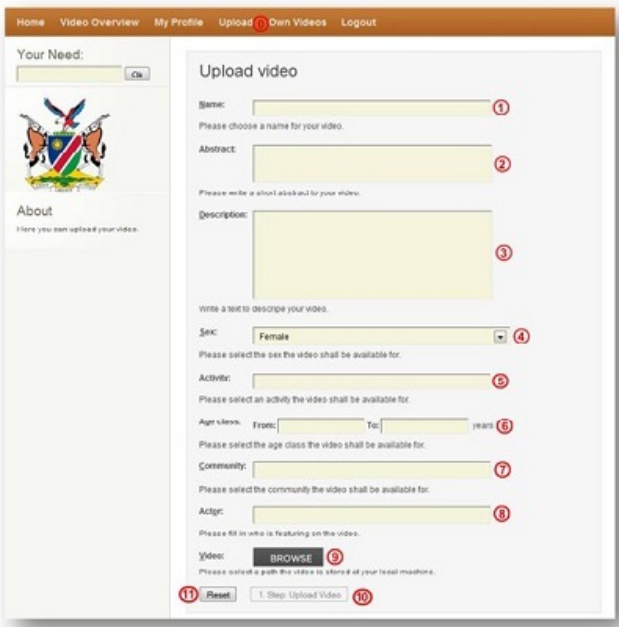

Figure 2: Video upload mode (Kapuire et. al. 2010)

4.1.1 Features

The system was based on a classical meta-data organisation with a number of specific fields to facilitate retrieval. The interface was text-based (see Figure 2) where when a video got uploaded, meta-data had to be entered manually. All users had a static profile which identified them to be a "narrator" (able to upload video) or a "listener" (able to retrieve videos). The "narrator" would determine which kind of listeners the video is targeted at. While the listener could enter search terms as well as "information need" which together with the profile would retrieve the appropriate videos. As some rural dwellers can understand "English" the interface language was in English while the meta-data entered was in Otjiherero.

4.1.2 Usability Evaluation

During a field trip to the village, the prototype was tested in order to evaluate its suitability, the functionality and usability of the prototype. At first the prototype was explained. Secondly, the user started to interact with the system by login on. When logged on, the system was explained again thoroughly. The users started to interact with the prototype with continuous explanations as needed. Users were asked to complete 2 tasks.

Task 1: The narrator logs onto the system and enters keywords on the search criteria to playback a video. Than uploads a video clip recorded from a flip camera, which is on the local machine. Respective metadata is than entered and saved. The user plays back the uploaded video.

Task 2: The listener logs onto the system and enters keywords on the search criteria to playback a video. The user views all the video he/she can see.

During prototype testing, there was a lot of hesitation from the community members. They struggled to relate videos to single words and entered keywords into the metadata fields on suggestions only. When playing the video again, they didn't understand why they needed to enter keywords to search for a video of their choice. It took more than five minutes in order for the users to type in the search keyword for the choice of video. The entire concept of metadata was not well understood.

Besides only a few community members have sufficient English, reading and writing skills to operate the interface. Entering metadata in their own language did not ease the use as spelling in Otjiherero is not necessarily standardized.

More general usage like login, uploading of videos, starting an application was also new to the community members operating a computer for the first time in their life.

It was concluded that the usage of meta-data for videos as well as profiles for users would only be useful for internal data organization but not at the interface level and not with manual entry by the users.

4.2 Prototype 2

A major paradigm change was decided on by ensuring that no text would be used for the next prototype. Design ideas based on the outcome of the first prototype evaluation were used and a new attempt to map real-life communication structures was developed. This time the students from Germany went to the village to test the prototype with the usability tester. The approach was to develop a user interface entirely based on images and audio output. Audio input was not pursed because of the complexity of speech recognition which is beyond the scope of this project.

4.2.1 Features

The system was implemented as a video sharing platform based on the real-life scenario: The narrator determines who should be listening to the story. If the narrator feels like sharing the story the narrator would call a group of people to come listen to the story. If the narrator feels that only a specific person is to listen to the story the specified person is called.

The system login was implemented with a speech output telling the user in Otjiherero to select their photo (all community members photos appeared on the login screen) (see Figure 3). The owner of an uploaded video could enter metadata via selection of images and thumbnails such as who took the video, who is the main narrator on it and what event does it depict. In the video sharing mode the owner of the video could drag video clips into the baskets of the fellow community members (see Figure 4). Once one of them logs on he/she would find the video in their baskets for viewing. If the video was locked by its owner the video could not be further shared.

4.2.2 Usability evaluation

The prototype was once more evaluated in the village by a number of dwellers in a group setting. The users were given the tasks to explore, upload a video, share it and then another person logs on to view a shared video.

This time no hesitations were observed and the users enjoyed the usage of the prototype. Login on was intuitive yet the uploading of the video still presented the users with challenges. Although the sharing concept in principle was understood the usage of the mouse and the touchpad was problematic.

In general it was observed that much more ease of usage than with the first prototype was experienced yet still a lot of explanations had to be provided. Also too much clicking and dragging as an interaction technique was problematic. While the speech output was well received it should have been louder and repeatable. Much more research would still be required in the appropriate speech interaction and choice of voice.

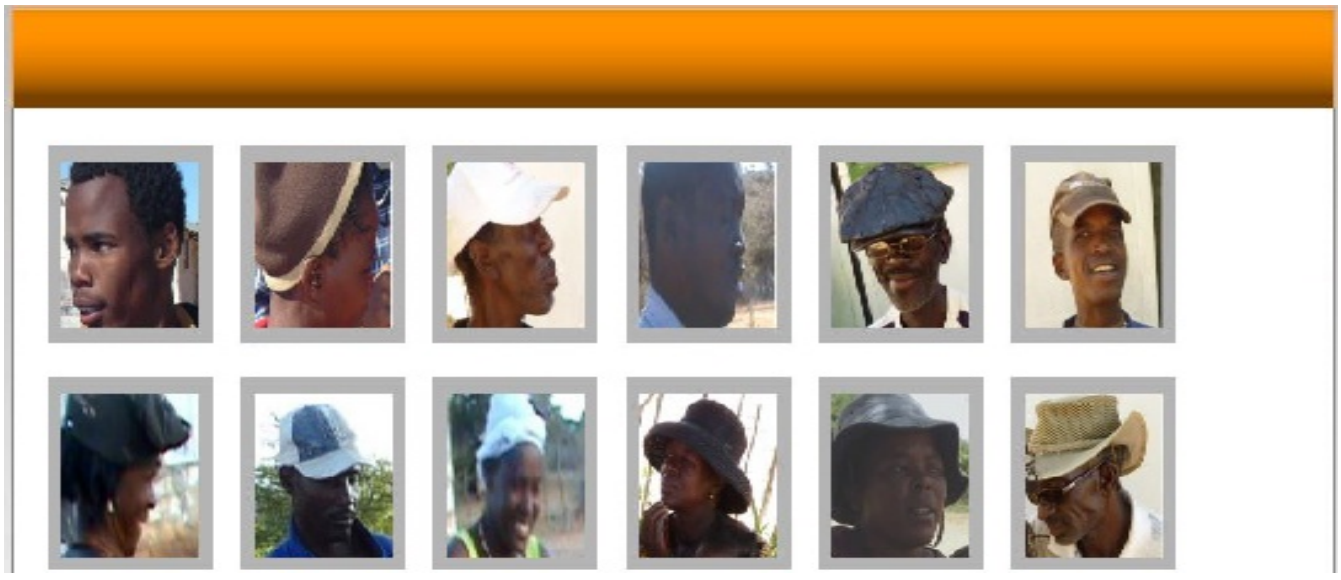

Figure 3: Login screen [5]

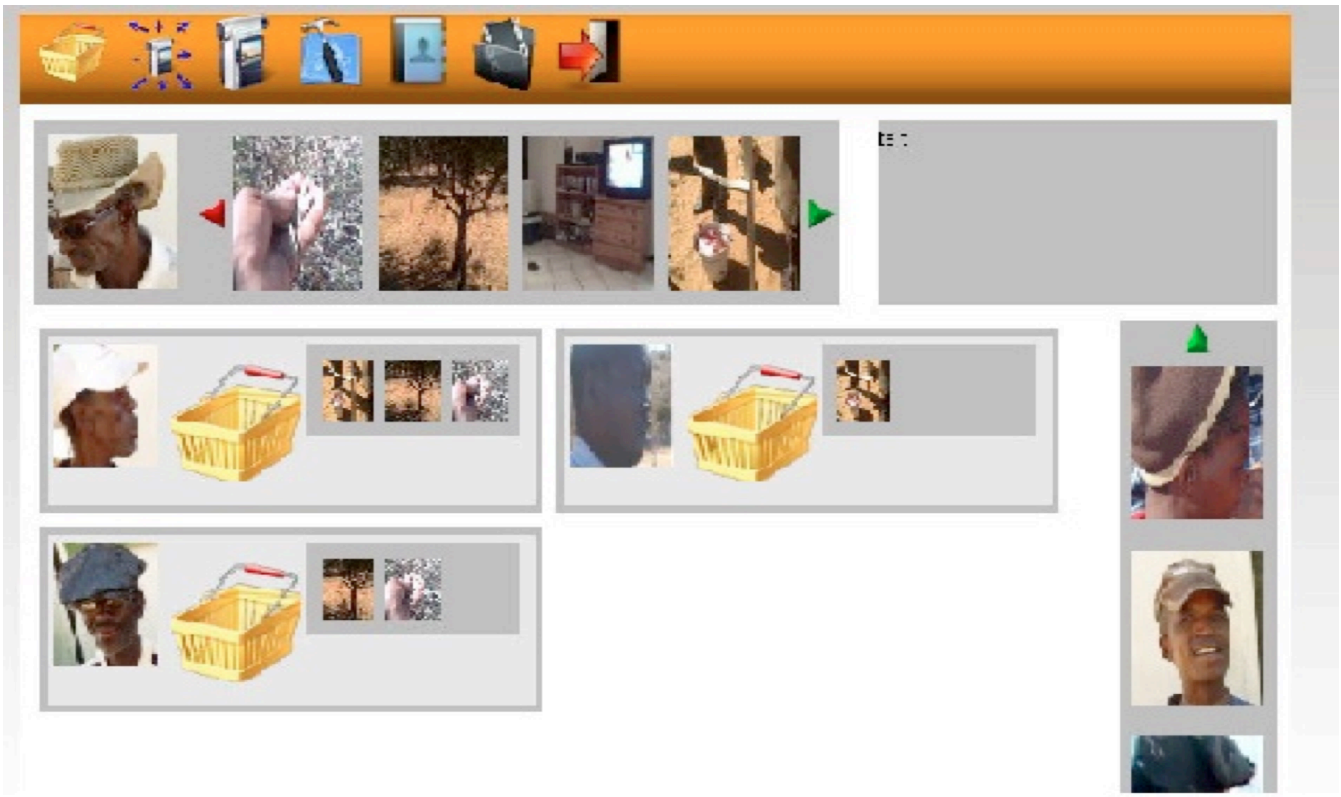

Figure 4: Video sharing mode [5]

4.3 Prototype 3

With the third prototype an entirely new field was entered, namely 3D visualisation and re-contextualisation of videos. The motive of the prototype was to embed the videos into the visualisation of the environment where it relates to the different places where elders share their knowledge with others. The prototype was developed by students from Denmark.

Figure 5: The visualization including all the 3D objects constructed from references in the village (Rodil et. al. 2011)

4.3.1 Features

The prototype was a 3 dimensional representation of the village. The prototype had graphics to represent different scenarios based on the real setup. Rodil et al. (2011) describes the system whereby various mechanisms are used: firstly, by embedding videos in a recognizable 3D visualisation of highly familiar features of the users' village and populate this with generic models of people; secondly, beyond graphically modelling the village scenarios were created at the locations at which videos are embedded, whereby the scenarios are animated models of people associated with an audio narrative; thirdly, no paths between scenarios were described, but rather modelled some of the paths that farmed animals follow through the village to provide some of the patterns that villagers use to navigate their setting.

High graphical resemblance was used for the 3D Visual representation of village consisting of trees, bushes, few man-made objects, houses, fences, water-pump, fire places, and car tracks (see Figure 5). The relative positioning was based on the author's memory to support ease of recognition. Scenarios were modelled based on video content and gestures were to indicate specific actions, like a story being told. Users navigate around the village to the different scenarios by using drag-able mouse interaction.

Each scenario represented the trigger for an uploaded video (see Figure 6) which the user could activate and view in a 2D plane.

4.3.2 Usability evaluation

The prototype was tested by elders and the youth of the village in two groups [8]. They started looking around trying to identify the visual with the surrounding. They recognised the fire as they pointed to it as well as the houses in the surrounding. They started associating the elements in the visual representation to the real places one by one. One community member said that it looked familiar to the real setup. The prototype was trying to map the actual experience familiar to the community people by 3D visual representation, so that the people could start seeing as to how they would share knowledge.

Figure 6: Scenarios act as triggers to launch a video as a 2D plane in the visualization. Here the scenario includes Elders transferring information on branding cows and maintaining the herd [8].

In general, users were comfortable with the prototype as they could identify icons like cattle and people presented. They also had numerous improvement suggestions on very detailed level such as the choice and representation of scenarios and other graphical representations.

It is concluded that embedding videos in a 3D simulation is a novel and promising approach which will be pursued further.

Figure 7: Usability evaluation session

5. RELEVANCE TO REALITY

In the actual world an elder would have stories on his mind. The elder would then decide who the listeners should be and tell the story to them for the purpose of teaching or entertainment. The listeners are able to convey these heard stories to other listeners while some stories remain a secret between the narrator and the listener.

5.1 Prototype 1

There is no mapping to the real setup on how videos are shared. The listeners could listen to a video uploaded by a narrator, but due to constraints, there was no video organisation as a narrator could upload all the videos he owns, and in the real setup, the narrator might have videos that are associated to each other. So when a video is uploaded, the listener could view videos one by one, not knowing which videos should be listened first before another one continues. Thus the approach of metadata will only be used as internal additional categorisation and automatic tools will be explored to extract the data out of the videos directly.

5.2 Prototype 2

It maps the sharing mode of using a basket, whereby a narrator can have a couple of listeners. The narrator can decide who should listen to a specific story. The narrator can log videos which the narrator owns. The logged user being the narrator, was able to see the listener, and to drag the video he has to a person he wanted the story to be told to. The listener profile was shown, so that the narrator can see what videos are in the basket that he can share with others. When the narrator is logged on, thumbnails of the video where displayed, the ones where the logged on person has no access to should be locked, and can only be opened by the owner. The uploaded video by the narrator was placed in the basket of the narrator. The uploaded video is displayed on the list of the narrator. The metaphor of knowledge sharing with the baskets was well understood and can be further explored in the following prototypes.

5.3 Prototype 3

As the community members identified the 3D representation of a homestead, it made the community people view the scenarios based on the actions, even though the community members could not organise videos to present it to specific listeners but rather geographically. The representation was so real to the users, which made them feel like the real village. The challenge here is once the amount of videos per location increases additional mechanisms of selection must be defined.

6. TOWARDS OUR NEXT PROTOTYPE

It has shown that concentrating on user requirements is essential as this drives the development process by demonstrating and stating life setups wherein ideas will be collected for the significant ways by which knowledge is organised and retrieved. Based on the different prototype explorations, it has shown that the users are most comfortable with graphics and photos. The 3D visual representation of the village was well adapted as it reflected what they see in the rural environment. However having a pure location based organisation is insufficient. Thus further development will integrate the two approaches of the last prototypes with a person-bound and location-based allocation of videos. The sharing mode must be done in a way that videos can be represented in a way that it maps the real lifestyle. In future, work will be explored on the usage of agents. Also to identify appropriate categorisations for videos at the user interface level more design and evaluation sessions with the community members will be held. Once that has been identified, the organisation structure should be mapped onto the prototype. The concepts of who the narrator wants to tell the story to, how many stories the narrator wants to share, related stories not connected should be finalised. Related videos will be linked together so that when a listener is listening to a video, the listener can listen to associated videos. All this must be mapped onto the system.

7. LIMITATIONS

This research project has been on-going from the time the target group was identified. Irregular and sometimes short field trips limits the time of interactions with the rural dwellers and the opportunity for deeper understanding of the knowledge system. The development took place remotely based on field notes. One way to overcome this would be to try to extend field trips to several weeks or months, depending on how practical it would be in terms of ICT and electricity infrastructure. Despite, having

these limitations, the community engagement led to a number of important design ideas and decisions.

8. CONCLUSION

In the search for an appropriate representation of a collection of videos to be shared between rural dwellers and urban youth, classical and new approaches were explored. The standard method of metadata only seems suitable to societies who have a long history of term and concept based knowledge organisation. The people bound and location based approach of organising knowledge maps African indigenous knowledge systems based on oral and performed knowledge transfer much better. However little research has been done in this field therefore the need to explore new ideas with the community and carefully evaluate results over time.

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