Creative Cameraphone Use in Rural Developing Regions

David Frohlich,[1] **Simon Robinson,**[2] **Kristen Eglinton,**[1] **Matt Jones,**[2] **Elina Vartiainen,**[2]

[1] Digital World Research Centre
University of Surrey,
Guildford, GU2 7XH, UK
{ d.frohlich, k.eglinton } @surrey.ac.uk

[2] Future Interaction Technology Lab
Swansea University, SA2 8PP, UK
{ s.n.w.robinson, matt.jones,
e.vartiainen } @swan.ac.uk

ABSTRACT
In this paper we consider the current and future use of cameraphones in the context of rural South Africa, where many people do not have access to the latest models and ICT infrastructure is poor. We report a new study of cameraphone use in this setting, and the design and testing of a novel application for creating rich multimedia narratives and materials. We argue for better creative media applications on mobile platforms in this region, and greater attention to their local use.

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Mobile; storytelling; cameraphone; development.

ACM Classification Keywords
H.5.m [**Information interfaces and presentation**]: Misc.

INTRODUCTION

Recent developments in mobile computing often assume an always-on infrastructure in which devices can connect to each other and the web. For example, portable navigation systems and location-based services rely on GPS coordinates being available from a satellite and usable in remote web searches. However in many parts of the world this infrastructure assumption is not true [27]. Although the use of mobile phones is increasing exponentially in so-called developing countries, many of these phones cannot connect to the internet, and for those that can, the cost of using a connection may be unaffordable by large parts of the population. Even when users can afford to connect, further barriers to use include language diversity and low textual literacy. Web-based information may not be available in local languages, and low textual literacy will inhibit the kinds of interactions that users can undertake on a mobile phone, using textual menus, textual content and free-text entry. In these circumstances, it is important to consider the value of cheaper services running over more restricted forms of infrastructure, as well as more localised uses of the mobile phone platform that are less reliant on text.

In this paper we report further results from the Community Generated Media project that has been addressing these issues in Mankosi, a rural region of the Eastern Cape in South Africa. The focus of the project is on mobile digital media sharing in a community context, building on previous work by members of the project team in India and South Africa [3, 9, 11]. The sharing of multiple forms of media in pictures, sound, video and text is something that is already enabled on a wide variety of cameraphones, and does not necessarily rely on a mobile internet connection. It also extends existing practices of analogue media sharing represented by community radio, theatre, newspapers and television. These are more popular and valuable than internet use in many parts of the world, and stand to gain enormously from digitisation in various forms, not least in the area of mobile production and consumption.

Previous research in the Mankosi community has reported on the use of free 'callback' services on low-end phones to save money on text messages [2], and the deployment of an asynchronous audio sharing system [29]. In this paper we trace the development and early use of a 'MultiMedia Narrative' (MMN) application, based on insights from a study of cameraphone use in the region. The aim of this paper is to reveal the many ways in which local people derive benefit from their existing cameraphones, and how these effects can be accentuated by the provision of simple multimedia narrative capabilities in future phones.

We begin by outlining related work and the community context before describing the cameraphone study in brief. This leads onto an explanation of the design of the MMN application itself and the way it was received and used in a series of 'storytelling' workshops with local community groups. The paper ends with a discussion of the implications of our findings for mobile computing in this and similar contexts. We will argue that the cameraphone has the status of a multimedia entertainment and communication device in developing communities, and would benefit from additional facilities for locally archiving and remixing content in creative ways.

RELATED WORK

In a review of over 200 studies of mobile phone use in developing regions, Donner [7] provides a framework for mapping out differences between them. This can also be applied to studies in other parts of the world and is useful here for understanding work related to the current study. Donner distinguishes between studies concerned with the use of the mobile phone to aid social and economic development (Information and Communication Technologies for Development; ICT4D studies) and those concerned with the more general use of mobiles in society (non-ICT4D studies). In each category,

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he points to studies of mobile adoption, mobile impact and mobile interrelationships with everyday life. Our work falls into the latter area, since it seeks to understand and then enhance the use of cameraphones for both personal (non-ICT4D) and community (ICT4D) benefit. In fact, we begin by conducting a study of personal cameraphone use in order to take a step back from our previous work on community media for development. We then seek to use the findings to design an application for community media sharing that is better fitted to what individuals are already doing on their mobile phones.

One reason for starting with a more general view of cameraphone use in rural South Africa is that there are few non-ICT4D studies of cameraphones in this geography compared with those in the US and UK. Donner lists many studies of the non-ICT4D use of mobiles across the world, but these often focus on patterns of calls and text communication rather than photographs or media sharing (e.g., Horst and Miller [14]; see also [5, 16]). Other studies have examined the use of mobiles in sharing pre-recorded audio and video media [19, 26, 30]. In contrast, there have been several non-ICT4D studies of cameraphone use in the West, where the devices are used in conjunction with other technologies such as computers, photowebsites and social networking sites.

For example, Kindberg et al. [17], in a study of 19 UK and 11 US participants, show how the cameraphone is used to take familiar snapshots for remembering special events, but also to exchange more playful images to enhance or share live gatherings and to capture functional image reminders or items for a shared task. A more recent series of studies illustrate a variety of 'downstream' activities from cameraphone use involving uploading, tagging, sending and archiving images [1]. In contexts where other receiving technologies are reduced or absent we wondered whether the same uses of images would still apply. Other studies in the West have also found evidence of 'lightweight' and 'heavyweight' video capture and sharing, albeit on a smaller scale compared to photo sharing (e.g., [18, 22]). Comparable studies in developing communities have looked at more facilitated forms of multimedia content creation and sharing for development. We mention this now as a final backdrop to our current design and evaluation work.

Community media production has long been a part of development work, and is thought to give communities a stronger voice in the development process (e.g., [32]). This effect has been accentuated recently by attempts to apply a digital storytelling approach to development contexts. This refers to the creation of short two-minute personal stories in photographs and voiceover, originating in California in the late 1990s [20]. Facilitation of digital story creation in community workshops using scanners, cameras, dictaphones and multimedia computers has been tried in a number of contexts around the world [12]. One value appears to be the expression of community issues and information in a more sharable and accessible form [13].

This approach has been condensed into the provision of digital storytelling software on mobile phones, which are a cheaper and more pervasive technology in development contexts. Thus Frohlich et al. [9, 11] developed a 'story phone' as part of the StoryBank project in rural India. This allowed the creation of short audiophoto narratives comprising up to six images with up to two minutes of synchronised voiceover. Stories could be uploaded and downloaded from a community library and touch screen display, and were useful for sharing both practical and cultural information of local interest. A similar approach was used in a multimedia phone application developed in rural South Africa by Bidwell et al. [3]. This used a more flexible 'carousel' of images with associated sound clips to support the capture of both contemporary and heritage stories, and indigenous knowledge. Both these prototypes had their own usability issues and excluded the use of text and video. They also resulted in stories that were not easily shared or exported. Related prototype story-phones in the West (e.g., [15, 21]) result in standard MMS messages or MP4 video files which would be expensive or impractical to share in developing areas.

Figure 1. The landscape of the Mankosi region.

In the work that follows, we examine the naturalistic use of cameraphones in a rural South African setting to re-consider the design of a story-phone for that region. By looking at existing practices of cameraphone use in this area we hope to fill a gap in the literature whilst identifying more precise requirements for mobile media sharing in general.

COMMUNITY CONTEXT

Mankosi is a district in Nyandeni, Eastern Cape, South Africa. The community has a population of approximately 11000, spread over twelve separate villages. Villages are formed primarily of scattered rural settlements, most of which consist of small groups of rondavels (see Fig. 1).

Infrastructure and services are very limited, and community members do not have domestic access to mains electricity, water or sanitation. There are high levels of poverty, and the majority of the residents of the Nyadeni municipality have either no income (36 %) or less than 800 Rand per month (41 %; $120 approx.) [24]. Electricity availability is very low, and generators and solar panels are uncommon due to their expense and the risk of theft. Two solar-powered mobile phone charging stations, sited here as a separate part of this project, provide some access to power for mobile phones, however.

Literacy levels in the community are low, but Mankosi people have a rich oral isiXhosa-speaking culture, and mobile phones

have become an important part of this. Mobiles are the main method of long-distance communication, but due to the expense of airtime many people make use of free text-based services such as 'callback' [2]. The majority of the mobiles used locally are low-end keypad-based models. An increasing number of phone owners use their device to take and view photos and listen to music, and a smaller number use their phones to record audio. Bluetooth sharing of media between mobile phones is reasonably common, due to the great expense of network-based sharing methods.

Access to the community was facilitated through a partner organisation by a member of the project team living full time in the area. TransCape was founded in 2004 initially to help with HIV/AIDS problems, and now runs a variety of health, education and microfinance programmes to counteract poverty in the region. Nicola Bidwell lived as a situated researcher in this area for four years, conducting ethnographic action research on local technology use and design. With a team of local researcher/translators Bidwell helped set up many of the interviews and workshops, hosted us on visits, and advised on local customs and lifestyles whilst leading a parallel project strand of research on a MXit[1]-based media sharing system.

CAMERAPHONE STUDY

In April 2011 we travelled to Mankosi to get a better understanding of the ways in which community members were producing, consuming, and sharing audio and visual material on their phones. To get at these processes we conducted a small-scale qualitative study which employed ethnographic observation, individual and group interviews, as well as two salient digital methods we called *mobile media-elicitation* and *multimedia portraits*. These digital methods were used during both group and individual interviews. Mobile media-elicitation was based on photo-elicitation techniques, but contextualised for a region with no electricity or venues to develop photos. It included asking participants to talk about (and when possible show) media stored on their phones. Participants were asked about their favourite images and other media such as voice recordings and music on their phones, as well as media that they would 'never delete.' The multimedia portraits included engaging participants in getting their photo taken and then, with the help of a local researcher, recording 'why the phone is important to them.' These audio recordings were later layered on top of the image as a kind of audio-photograph (cf. [11]).

Arriving in the community in early April, time was spent in the villages learning about the context, and recruiting participants. The central criterion for participant selection was ownership of a phone which had a camera built in. Overall, 28 people aged between 18 and 60 participated in one of the 17 individual or group interviews. The majority of participants were female, and aged between 18 and 30.

Using mobile media-elicitation all participants were asked to show us or to talk about their 'favourite' content on their phone. Taking out their phones many people shared images of themselves and of the community; images of friends, family, and distant relatives were common. However, it was just as common for them to show us favourite music clips and other media stored on their phones. For example, people spoke about the importance of conversations with friends recorded on their phones. Others referred to video clips of their children singing and dancing. In the remainder of this section we describe several of these findings, beginning with photos, and followed by sound and video. A more detailed account of the findings is also in preparation (see [8]).

Figure 2. An example portrait photo from one of our participants.

This was a favourite photo of one young woman, marking a time before she got married. As she put it, the photo was taken at a "time when [she] was young single, nice and beautiful."

Images of self, family and community life were often shared with us by most participants. However, unlike the casual and spontaneous images found on cameraphones in the West (e.g., [17]), many of the photographs were stylised and posed. In fact they were typified by *portraits* of individuals taken at significant moments or simply when subjects were looking their best. Many were self-portraits or portraits of the phone owner taken by others (see, for example, Fig. 2). Multiple participants, particularly female participants, told us how they took photos of themselves to share via Bluetooth with their husbands so their husbands could have the images before they left for work outside of the villages. Images of children, family, partners and friends were also shared with us. These images were captured for various reasons including people asking to have their photograph taken, marking an event, or to share with others often as a means of managing long distance relationships. Friends and family asked to be photographed so the picture taker could both remember them and share the image with others. Finally, others spoke about how they take images of friends and family, images which later trigger memories. One young woman spoke about her favourite picture on her phone; it was of her best friend she met at boarding school who lived far from the village. As she told us:

> *"This picture reminds me a lot of things because the first time I met this girl it was like, we didn't plan to be the friends but it just happened like that because we were in the school last year [. . .] we started to talk, started to ask where we live, where we come from, then it just, it was the first day that we start to be the friends. So this picture I like it a lot because it reminds me everything."*

The propensity to dress up for special portrait photographs was also illustrated by reactions to our method of taking a multimedia portrait of participants with their phones. This was treated with intense engagement and often resulted in elaborate preparations, a change of clothes and a large audience gathering to watch. Consequently the resulting photographs were highly valued and participants asked to keep them on their phones as souvenirs from the study. This behaviour is also consistent with participants experiences of interaction with a local 'cameraman' who could be hired to take individual printed photographs delivered the next day.

[1] An SA-based instant messaging and chat platform: www.mxit.com.

Although more casual photographs were also captured on phones, their use may have been curtailed by another issue specific to the developing community context. Most participants had no other devices to backup their photographs to. This underscores the lack of other common technologies taken for granted in the West, such as home computers, laptops and other storage devices that were entirely absent from the Mankosi region. Consequently, participants in our study had to constantly juggle with the tension of capturing media on their phones and deleting it to make room for new material. This meant that more casual and transient event-based photographs may be captured, shared and deleted, in favour of archiving more stable portrait representations of self and others.

People's favourite media on their phones went beyond still images. Sound or audio and video were oft-cited media people captured and shared. Sound included both voice and music. Looking closer at this, many participants spoke about using the voice recorder on their phone to capture and later listen to friends talking, joking, or singing. One young man who sang in the choir told us how he would use the voice recorder to record and then listen to himself singing when he was alone. A young woman spoke about recording herself singing on her phone and then playing it back to *"see how [she] sounded."* The voice recorder was used to capture community and conversations with friends. One of the young men told us how he recorded himself and his friends *"speaking about the soccer ball"* (i.e. football). He said he recorded the conversation so that he could *"re-listen to news of the ball"* when he returned home that evening. A young woman spoke about recording her children's voices, and another told us how she likes to use the voice recorder to capture people talking about *"good news."*

Within the theme of sound or audio, music was of central importance. Every participant referred to capturing and sharing music on their phones. Asking one young woman to share the most important media on her phone, she immediately played us a reggae song, and told us how her husband is a *"rasta man."* Others spoke about the capture and, often more important, the sharing of music as one of the most important capabilities of their phones. The importance of music cut across all ages. Even Elders cited *"listening to music"* as an important part of their phone. Gospel music, followed by R&B and pop music were the most highly consumed genres. The sources of this music varied. Some participants spoke about using the voice recorder to capture music from the radio they played in their home; many got their music from other people's phones via Bluetooth. Several young male participants went to the nearest town and bought songs downloaded from the internet. These songs were then brought back to the community and shared from phone to phone. Depending on the battery life, music was listened to on the phones intermittently throughout the day. Music was sometimes consumed using headphones, but more often it was shared *"into the air."* Many participants told us how they would share their Gospel music with their children by playing the music through the speakers of their phone. As one young male put it: *"sometimes when we are actually all together with kids and stuff like that we play the phone and the kids will dance and have fun."* Indeed, the phone sometimes operated as the family stereo, where music was played as people went about their housework or entertained visitors.

This idea of the phone as a site of multimedia entertainment or multimedia production and consumption is also threaded through participants' use of video. Video capture was often referred to as *"videolising."* Video usage included the production of video content from the community, as well as the capture of video from popular culture sources. For example, one young woman spoke about how on her last visit to the nearest city she used the video recorder on her phone to record a football match from a TV. In particular, she described how she recorded the match by holding her phone up to the TV for the length of the game. She later shared this match with a friend who, she claimed, asked her to record it for him. Local football games were also captured on video using phones. One young man told us about videoing the local team playing football, and sharing the footage with friends. Numerous women spoke about videoing community life, including church services and the choir. An older woman described how she uses the video and the voice recorder on her phone to capture *"pictures in church when the choir is singing."* She then shares the content with friends and neighbours who cannot make the long journey to church by foot. In another example, a younger woman used her phone to record people in the local shebeen (informal bar); she would then play the recordings back to other patrons.

MULTIMEDIA NARRATIVE APPLICATION

These findings on the existing use of pictures, sound recordings and video clips on cameraphones, suggest a number of enhancements that might be made to the cameraphone platform as well as an opportunity to combine media into a richer narrative format.

Greater attention might be given to sound and image quality to enhance recording and playback on the device itself. Methods of docking, relaying or projecting content for presentation to larger audiences should be considered, as well as capture via Bluetooth or the internet. A reverse camera would improve the taking of self-portraits, while a line-in socket would support the capture of audio from other sources, such as radios. Media mixing might allow different combinations of sound and image with judicious use of text by which to index the results. Lightweight text annotation fits with 'callback' activity observed in low end phones of the region [2]. Media formats should be extensible to allow social commentary and responses to media. Local memory and battery capacity should be large enough to support long-term storage and long-duration playback, but software designs should take into account these limitations. Oral and musical traditions suggest particular attention to sound design which might support the layering and concatenation of multiple sound channels.

In short, the findings suggest a design transition from cameraphone to 'mediaphone' in this region, to support and extend the mobile media practices already in play. This might not necessarily have all the facilities of a smartphone to access the internet continuously, but it would have better media handling facilities and, in addition, would support more creative capture and mixing of multiple media forms for audiovisual entertainment and communication.

With these requirements in mind we developed a MultiMedia Narrative (MMN) application for both cameraphones and

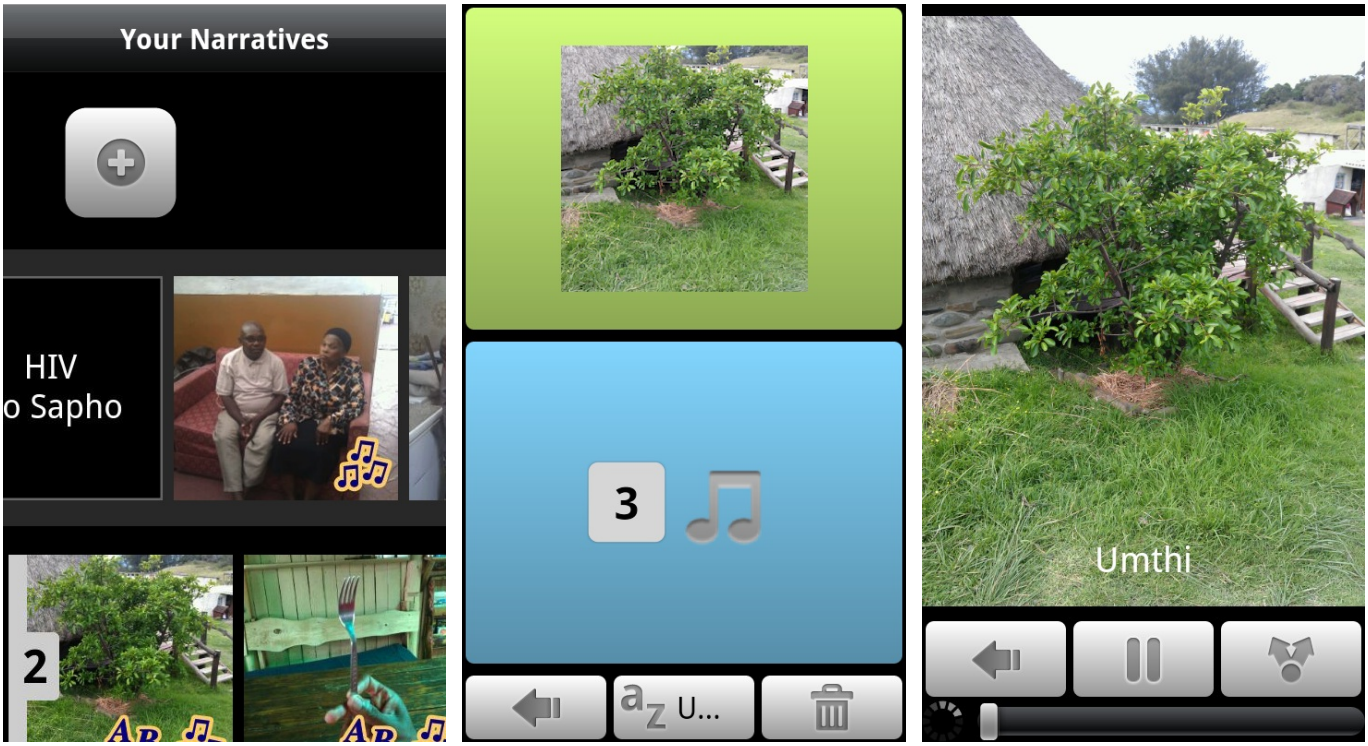

Figure 3. The MMN application. Left: a stack of narratives on the main MMN screen. Users can scroll up and down between narratives, and left to right between frames. The '+' button inserts a new narrative at the top of the stack; an identical button is shown at the end (far right) of existing recordings to allow users to append a new frame to any narrative. Holding down on two consecutive frames inserts a new frame between them. Centre: options for recording a multimedia frame. This example frame currently contains a picture (top), three simultaneous audio tracks (centre) and text (bottom, centre). From this screen users can also delete the frame (bottom, right), or return to the main narratives screen (bottom, left). Right: playback of a narrative. When playing, text content is overlaid on imagery, and audio tracks are played automatically. From this screen users can also export the narrative in the SMIL multimedia format, sending to other devices via Bluetooth.

smartphones. The application allows currently separate media streams to be combined creatively into multimedia narrative clips, thus extending the expressive properties of the phone for information, entertainment and communication. In the rest of this paper we concentrate on describing and testing the high-end smartphone version of the application, in anticipation of the future affordability of smartphones in developing regions, and because this affords greater capabilities for high-quality media creation, playback and sharing. However, both versions will be released as part of a free open source community media toolkit in the summer of 2012. Although the application was developed for this rural South African region, it relates to key aspects of storytelling in general. We therefore hope it will have a more universal appeal outside this context and be taken up by a variety of groups around the world.

The high-end application runs on a standard Android phone, has a fluid touchscreen interface, and allows users to record images, audio and text along a flexible and extensible timeline structure. Our aim was to allow people to create sophisticated narratives, combining any of these three media elements using a simple interface. This comprises a narrative 'storyboard' of frames on which sound, image and text elements can be built up into a 'story', and exported to a variety of different devices and platforms. The application supports multiple layered audio streams such that the user can record several audio tracks, each of which will be played simultaneously when the story is replayed. After some deliberation we excluded video from the media mix because many phones support separate video capture, and we wanted to preserve the economical storage requirements and expressive quality of audiophoto narratives.

This approach is distinctly different from more conventional video editing applications for mobile phones, then, allowing users to easily capture, edit, append, insert or retake media at any point of the narrative. Our choice of the frame metaphor is intended to prompt users to take photos or record sound during an event, but move beyond simple archiving of raw media elements by prompting later editing and combining of media into narratives. We also focus on generating small file sizes that can be shared with the low-end devices that are common in Mankosi and similar contexts.

Figure 3, left, shows the application's main interface. When the user first opens the application they are presented with a scrollable canvas of existing narratives, ordered by creation date. Dragging up or down navigates through narratives; scrolling left to right moves between the components of a single narrative – individual frames. Each narrative can be made up of any number of frames, and each frame can contain any combination of: an image (via the front or back camera); text; and, any number of concurrent audio recordings. This novel layered audio approach is designed to allow mixing with, for example, speech overlaid on background music.

The interface for capturing the media elements of each frame is shown in Fig. 3, centre. This design focuses around audio and photos, with less graphical emphasis given to text content. From this screen, pressing the camera button allows the user to take a picture, and pressing the audio button begins recording. While recording, pressing the same button again stops recording. Further audio layers can be added by repeating the process. At the bottom of the screen, users can return to the main narrative browser, add text, or delete the frame. We refrained from adding more complex recording and editing features (moving or merging audio recordings, for example) in order to keep the interface as simple as possible.

The system uses a timeline-based approach, but is completely flexible with regards to the components and length of each narrative. For example, a user could choose to compose a story entirely of audio and without visuals – an important consideration in Mankosi and similar communities [3]. Our application does not restrict the duration of individual frames, nor of narratives, and any element can be returned to, edited or extended at any time after creation. We imagine this feature as an enabler for extended conversations, allowing back-and-forth, minuted discussion between two or more parties where, for example, each could take a self portrait photo and then add their own views on a theme.

The application avoids the use of text in menus and icons, preferring an icon-based interface to support the literacy levels of the Mankosi community. Unlike some previous designs, however, we do not aim to prevent the use of text – we feel that text can be an important element in stories if people choose to incorporate it.

Recorded narratives can be played on the phone itself (full-screen), or shared with others by using the application's export feature. Stories are exported (and imported) using the SMIL multimedia format. This choice of format has two benefits. It allows for particularly small file sizes – especially important for further sharing and to cope with storage space limitations on other local devices. A typical exported three-minute MMN narrative with five photos, continuous audio throughout, and text on the first and last frames is approximately 560 kB in size. Secondly, this choice ensures that all the narrative's components are separate and therefore viewable on any platform, even if SMIL playback itself is unavailable.

While the phone application is self-contained, we also designed it to be compatible with two existing media browser tablet PCs that are attached to mobile phone charging stations situated in the community. The MMN application can send stories to a media browser via Bluetooth, and these appear as stories for public viewing. In contrast to other previous media sharing approaches (StoryBank [11], for example), with our approach, in addition to the narrative itself each of the story elements themselves are shared individually, and can therefore be repurposed by other users in their own sharing and storytelling.

MANKOSI STORIES

In October 2011 we returned to the Mankosi region to carry out workshops in which we showed the new MMN application to various community groups for feedback and use. Groups were chosen with the local situated researcher to represent important social institutions or collectives in the area, who already acted as information hubs and might benefit from multimedia information. They included two groups of voluntary home care workers who visited sick people at their homes, a group of tourist guides and hostel owners working with local tourists, members of a local church choir and volunteer staff from our NGO partners TransCape. Groups were asked to consider the use of the MMN mobile phone application for both community and personal use.

A series of five one-day workshops were held on consecutive days of the week with a total of 32 participants. Six or seven participants were present on each day, together with three representatives of the UK project team and one or two local researchers, who acted as translators. All sessions were held in the local isiXhosa language, except for those with TransCape staff who spoke English. Mornings were taken up with a discussion of group activity and a demonstration of the MMN application for feedback and discussion. After lunch, groups split into two halves to create narrative content of their own, facilitated by a UK project team member. Sessions culminated in the joint viewing and discussion of mobile narrative content downloaded onto a laptop for playback.

A thematic analysis of group discussions and created narratives was carried out to identify common themes regarding MMN value and use. It is important to note that these are hypothesised values and uses offered as part of an initial reaction to the technology, which may change in actual practice. This will be addressed in future publications dealing with subsequent use of the phones, which were left in situ in the community after we left, and managed by local researchers and our situated project researcher. Moreover, with the release of the MMN application as part of an open source toolkit we will learn a great deal about how communities react to and use the technology in their everyday lives. For now we report briefly on five potential uses which emerged from the analysis of workshop data alone. These uses cut across the personal and community dimensions which participants found hard to distinguish from each other in discussion. They include: advertising; multimedia letters; documentation; learning resources; and, healthcare advice.

Using multimedia narratives for **advertising** local services or events emerged first in the tourist guide group, where participants saw them as a way of communicating with tourists themselves. They wanted to make narrative films of local attractions and put them up on the internet for tourists to see – despite having no access to the internet themselves: *"We can record the caves and cultural practices here so that when tourists are coming here they must know what the expectations are [. . .] they can see the videos and get interested."* Subsequent content creation tried to realise this by building a narrative around a photograph of a printed advert for local kayaking trips along the river. Members of the choir suggested using the application to advertise church events and services. They also made an evangelical narrative for a forthcoming youth event comprising six frames. The narrative started with a picture of three girls singing a gospel song and went on to feature short testimonial talks by each girl in turn (to a profile

Figure 4. A short hymn recording, intended to be played to and left with a sick person. The initial title frame (not shown) says 'Singing.'

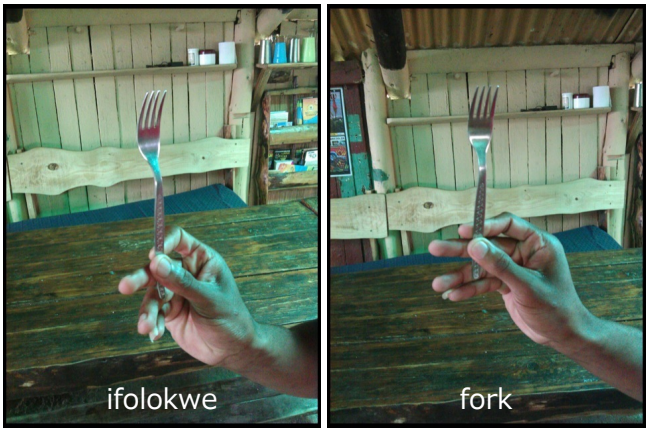

Figure 5. A multilingual flashcard showing the isiXhosa word for 'fork.' The words are also spoken three times on each frame.

picture) before closing with a picture of the bible with spoken appeal and final song to textual credits. When the elders of the group saw this later they were so impressed that they discussed showing it at the planned event. This raised issues of how to transfer narrative content made on the phones to other devices such as computers and televisions.

The tourist group were also forthright in suggesting a use of the MMN application for writing **multimedia letters** to government authorities. This was seen to give a new voice to those who could not handwrite conventional letters, and resulted in the creation of a single narrative comprising the spoken complaints of three tourist group members, set to their own portrait pictures. An opening text frame was entitled simply *"Mankosi (Tshani) Tourism Needs."* Complaints included descriptions of poor roads, sanitation and litter, with appeals for electricity, toilets and running water to boost tourism in the area. TransCape staff also mentioned the possibility of creating multimedia messages highlighting local issues, and made a similar narrative in text and audio, dealing with poor schooling, beach safety, forced marriage and the value of sport.

A logical development of the multimedia letter ideas was manifest in a very large category of suggestions relating to the **documentation** of community life. The mobile phone application was seen as tool for recording both personal and community events either as an enriched record to be shared with those not present, or as a kind of legal evidence that could be shared with authorities of various kinds. For example, narrative recordings were suggested for personal, family and cultural events like Xhosa weddings, dances and initiation ceremonies, as well as for recording meetings for live or later consumption: *"Maybe in a meeting I can share to the other person who is not in the meeting. If you are to take a decision you must also accommodate that person."* More serious uses of documentation included the proposed recording of crime or abuse to report to the police later: *"you can use it in cases of rape to take the evidence."* Several mentions were made of recording sports events, church services and musical performances to share with others or simply enjoy as a form of entertainment later. This was manifest in one short narrative recorded by four women from the choir group. After an opening title frame they sang a song in harmony, which culminated in a prayer (see Fig. 4). They suggested recording this on a visit to a sick person and leaving it as a gift of hope.

Discussion of recording some community events suggested using MMN content as a **learning resource**. This was true in the case of recording school lessons or church sermons which participants felt could be recycled in their own right to larger audiences. Recorded football and netball games were also thought to be useful for training players and referees: *"it can help us in the netball club because the rules are changing."* Some narratives for providing specific advice to children by elders were suggested and made in the home care worker and choir groups. These were thought to overcome the embarrassment of talking about difficult subjects such as sex or violence. In a similar vein, mini-dramas were made to provide a more vivid kind of advice or instruction on health or other issues (see healthcare advice below). In a non-healthcare example, a short drama was made to explain farming cooperatives using a textual title slide, two sketches and a picture of two people tending a garden together.

The scanning and circulation of printed materials such as school books or posters was also mentioned as a kind of learning resource, and the local creation of audio-photo books was suggested in the TransCape group as a reading aid: *"We don't have a reading culture but that could grow. You could make an illustrated book that's got voice with text. It could be a tool to educate people to read and write."* Another creative idea to emerge in this group was the ad hoc production of talking flash cards for language learning. Several were made very quickly in the afternoon session. A picture of an object was taken and annotated with the English and Xhosa words in text and speech. These were placed side by side in a two-frame narrative, as shown in Fig. 5.

The creation of multimedia narratives for **healthcare advice** was enthusiastically recommended by the home care worker groups. A very natural use was seen to be the recording of short dramas illustrating HIV/AIDS experiences and treatments, or those for other health-related conditions such as diabetes or domestic violence. These were felt to provide practical advice

Figure 6. A talking pill packet.

The voiceover explains that the pill "gives you energy, it makes appetite to make you eat more and more food. It is good to take these pills because if you are sick you have that power you want to eat more food. It gives you energy to get strong."

as well as bringing hidden topics into the open, to encourage discussion and self-revelation: *"it would be helpful to use the pictures, because people don't open up, so maybe when they see the pictures they say I am also suffering from this disease."* Participants were familiar with seeing live dramas about these subjects and took immediately to the creation of their own dramas in the afternoon sessions. These were the longest narratives recorded in the workshops comprising up to 11 pictorial frames with spoken dialogue lasting for up to nine minutes. For this reason they are the most difficult to illustrate here. Other contexts for recording health advice included remote diagnosis of emergency conditions, the capture of advice given by doctors and nurses in consultations, and the recording of verbal medicine instructions around pictures of medical packaging or patient record cards. A simple example of the latter use is shown in Fig. 6 which was a single-frame narrative describing the purpose of a packet of pills.

SECOND MMN PROTOTYPE

Feedback from the storytelling workshops highlighted several improvements to the application; consequently we have developed a second version. This supports inserting frames at the start of a story, and the recording of a single verbal narrative or music track against which to set individual frames (recently highlighted in [28]). This second version also limits the number of simultaneous audio recordings to three separate layers, allowing us to both explicitly highlight this feature and to allow users to easily re-record or delete individual layers.

The updated MMN2 application allows users to export their stories in an additional, more future-proof format. It uses an HTML5-based container with media components base64-encoded and embedded in a single file. While this adds 20 % to 30 % to the size of an exported file (the three-minute example given earlier is around 120 kB larger, typically), we think this choice is necessary to extend compatibility and allow more widespread sharing of stories. This export format still preserves the open nature of individual media components, however, to ensure recipients and viewers are free to adapt and remix stories. We have also added the ability to export movie files that could be shared on services such as YouTube.

Perhaps the most exciting aspect for NGOs and other similar organisations is the ability of our new design to create story templates that could prompt, say, discussions about current issues, or act as a flexible multimedia-capable community survey. Any existing story can now be used as a template, and later loaded to be edited to incorporate new content in the same sequential format. The high- and low-end versions of the application will be made available as elements of an open source toolkit for mobile digital storytelling in mid-2012.

DISCUSSION

The aim of this work has been to consider the range of personal and community benefits of cameraphones in a rural South African setting, and how these might be enhanced. We reflect now on what we have learned in this respect from our two studies, which broadly addressed each issue in turn.

The study of cameraphone use delivered findings that were initially reminiscent of those from other studies reported in the literature from US and UK settings. The phones themselves were used for keeping in touch with family and friends, and photographs were taken to mark special events and relationships. However, the taking or staging of self-portraits was much more prevalent in this context, and seemed to indicate a strong interest in personal identity and its performance through images (cf. [31]). At first sight this appears to contradict lay notions of what it might be to live in a less individualistic and more community-centred culture, but is actually consistent with cultures in which pride is taken in clothing and physical appearance (e.g., [23]). In fact the whole question of whether aspects of phone use were for personal or community benefit appeared to confuse participants, as they thought of themselves as both community members and individuals who benefited personally in both roles. This was illustrated more dramatically in the second study where community activities such as advertising tourist sites or writing to authorities were seen to be of potential benefit to everyone.

The use of sound recording was another distinctive feature of cameraphone use in this region that was not reported in early studies of cameraphone use in the West. Local recordings made up the majority of clips and comprised local music performances, everyday conversations including jokes and stories, and commentaries on live events such as football matches. In addition, participants reported capturing popular and folk music clips from the radio and collecting other pre-recorded music from visits to urban centres where they could access the internet or receive downloaded content from intermediaries. These findings echo those of Kumar et al. [19] in India and contrast with specific studies of mobile sound capture in the West, which have shown a preference for ambient sound recording to support memory for events [6, 10, 25]. They also contrast with mobile music practices in the West involving direct downloading of internet content or synchronisation of mobile devices with digital music archives on a home PC (e.g., [4]). Entertainment appears to be the dominant motivation for sound recording and capture here, but the mechanisms for realising it are different. They reflect a bias towards the local recording of self-made media and transient audio broadcasts, over the direct downloading of internet content from mobile handsets themselves.

Some propensity for video recording was also evident in the study, but this was further constrained by the limited storage capacity of phones in the absence of backup facilities, and the

time taken to transfer video between devices via Bluetooth. All this suggests the need for greater attention to sound as well as image recording on phones designed for regions like Mankosi, with local playback from the phones themselves. Our MMN application was designed with this in mind and provides new facilities for the combination of three separate media types: image, sound and text. This amounts to a kind of 'annotated audiophotography' application, oriented more to the creation of multimedia narrative items, than the capture of audio-augmented photographs.

Our second study showed that local people perceived many possible benefits of this approach, some of which they tried to realise in the narratives they made. The ability to combine media appeared to stimulate a creative imagination in many participants who got excited about what new media could be made and shared for different purposes. In general, people were impressed by how quickly short films could be put together in a series of simple frames, and were able to make two or more examples in a short space of time (with some assistance from a member of the project team). Although some of the suggested uses, such as documentation, could have been achieved by the capture of individual media, others could not. For example, the whole category of learning resource examples were based on the ability to combine oral and visual media in new ways, as in the language flash cards. Furthermore, there was something appealing to participants about the form of various combinations, compared with single media recordings. For example, although a football or netball match could be video recorded for playback to referees, it was the ability to highlight and comment on particular moves that was seen to be the attraction of the MMN application. This is similar to the argument used in digital storytelling, which is said to encourage people to go beyond the archiving of raw media elements such as photographs or sound recordings. The possibility of assembling particular sets of photographs and audio into a narrative structure invites authors to reflect on their personal meaning in a new way [20].

The findings were similar to those on the StoryBank project, where a multimedia story-phone application was trialled in rural India. A variety of cultural and development stories were created by different sections of the community, depending on their own interests and job responsibilities [9]. The stories suggested in our content creation workshops were similarly shaped by the background and interests of participants, and also began to show a diversity of content types and media forms. These related to health, education and advertising purposes as well as more personal ones such as sport and music. The biggest difference seemed to result from the lack of constraints on the length of media clips or narratives created with the MMN application. This resulted in some very long monologue recordings (within multimedia letters) and dramas of up to nine minutes duration. Again the distinctions between content created for personal and community use, entertainment and 'development' purposes, were challenged by our findings. As in other studies we found a strong motivation and practice of creating multiple media for personal and community entertainment, alongside a strong interest and aptitude for multimedia creation for professional use [26, 30].

In general, the findings point to some special features of mobile media sharing in rural developing regions which distinguish them from the kind of urban contexts examined by Smyth et al. [30]. At the simplest level, participants in Smyth et al.'s study lived in the busy metropolis of Bangalore, India, with access not only to cheaper 'Chinese set' featurephones with removable MicroSD cards, but also a ready supply of electricity and proximity to cybercafés and mobile shops offering low cost media downloads. Our participants often had to walk many miles simply to charge their phones, which varied greatly in age and facilities. Consequently, the default mode of media capture was local and self-made on the phone itself. Photographs, sounds and video clips were recorded in situ, juggled within the internal memory of the phone, and Bluetoothed to others in the region via face-to-face transactions. Pre-recorded media capture was limited to live recording of radio broadcasts, unless someone travelled to a town. In that case, music and video content could be brought back into the region by the traveller and shared with others in the community. Hence the sharing of pre-recorded media turns up in our study, but mainly as a by-product of human mobility and connectivity

The question of connectivity is a key one for rural South Africa, and other places in the world where ICT infrastructure is poor or patchy. Internet connectivity and cloud computing only really makes sense if devices have reliable connections to remote machines and data, and users can afford to upload and download content between them. Neither assumption was true in this region, yet users extolled the virtues of creating and sharing multiple forms of information on their mobile phones. If such phones are the only pervasive devices in the community, more attention should be paid to their local use and interaction so that they can substitute for other devices taken for granted elsewhere, such as televisions, radios, DVD players, computers, photo displays and the rest. For example, community meeting points could house app stores and libraries of shared content, accessed over a cheaper to operate local wireless network. Content might be refreshed and updated by human travellers moving between rural and urban regions and donating both collected and self-made media to the community. When mobile data services become more affordable, these local access points might be supplemented by remote providers. Elsewhere in the project we have begun to think about alternative architectures for this kind of situated media computing, which are asynchronous, intermittently connected and self-powering. This, in turn, may have implications for ubiquitous computing in the West, and how to make it more accessible and sociable, and sustainable in the face of disturbances in the infrastructure due to natural or man-made disasters or fluctuating costs.

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REFERENCES

1. Ames, M., Eckles, D., Naaman, M., Spasojevic, M. and House, N. Requirements for mobile photoware. *Personal and Ubiquitous Computing* 14.2 (2010), 95–109.
2. Bidwell, N., Lalmas, M., Marsden, G., Dlutu, B., Ntlangano, S., Manjingolo, A., Tucker, W., Jones, M., Robinson, S., Vartiainen, E. and Klampanos, I. Please call ME.N.U.4EVER: designing for 'callback' in rural Africa. In *Proc. IWIPS '11*, Product and Systems Internationalisation, Inc. (2011), 117–138.
3. Bidwell, N., Reitmaier, T., Marsden, G. and Hansen, S. Designing with mobile digital storytelling in rural Africa. In *Proc. CHI '10*, ACM (2010), 1593–1602.
4. Bull, M. Sound Moves: iPod Culture and Urban Experience. Routledge (2008).
5. Castells, M., Fernández-Ardèvol, M., Qiu, J. and Sey, A. Mobile Communication and Society: A Global Perspective. The MIT Press (2007).
6. Dib, L., Petrelli, D. and Whittaker, S. Sonic souvenirs: exploring the paradoxes of recorded sound for family remembering. In *Proc. CSCW '10*, ACM (2010), 391–400.
7. Donner, J. Research approaches to mobile use in the developing world: a review of the literature. *The Information Society* 24.3 (2008), 140–159.
8. Eglinton, K., Frohlich, D., Robinson, S., Jones, M., Vartiainen, E. and Bidwell, N. Mobile Media Production, Consumption, and Sharing in Rural South Africa. *[Unpublished manuscript currently in preparation]*.
9. Frohlich, D., Bhat, R., Jones, M., Lalmas, M., Frank, M., Rachovides, D., Tucker, R. and Riga, K. Democracy, design, and development in community content creation: lessons from the StoryBank project. *ITID* 5.4 (2009), 19–35.
10. Frohlich, D. Audiophotography: Bringing photos to life with sounds. Springer (2004).
11. Frohlich, D., Rachovides, D., Riga, K., Bhat, R., Frank, M., Edirisinghe, E., Wickramanayaka, D., Jones, M. and Harwood, W. StoryBank: mobile digital storytelling in a development context. In *Proc. CHI '09*, ACM (2009), 1761–1770.
12. Hartley, J. and McWilliam, K. Story Circle: Digital Storytelling Around the World. Wiley-Blackwell (2009).
13. Hearn, G., Tacchi, J., Foth, M. and Lennie, J. Action Research and New Media: Concepts, Methods and Cases. Hampton Press (2008).
14. Horst, H. and Miller, D. The Cell Phone: An Anthropology of Communication. Berg Publishers (2006).
15. Jokela, T., Lehikoinen, J. and Korhonen, H. Mobile multimedia presentation editor: enabling creation of audio-visual stories on mobile devices. In *Proc. CHI '08*, ACM (2008), 63–72.
16. J. Katz, ed. Handbook of Mobile Communication Studies. The MIT Press (2008).
17. Kindberg, T., Spasojevic, M., Fleck, R. and Sellen, A. I saw this and thought of you: some social uses of camera phones. In *Proc. CHI '05: Extended Abstracts*, ACM (2005), 1545–1548.
18. Kirk, D., Sellen, A., Harper, R. and Wood, K. Understanding videowork. In *Proc. CHI '07*, ACM (2007), 61–70.
19. Kumar, N., Chouhan, G. and Parikh, T. Folk music goes digital in India. In *Proc. CHI '11*, ACM (2011), 1423–1432.
20. Lambert, J. Digital Storytelling: Capturing Lives, Creating Community. Life on the Water Inc. (2002).
21. Landry, B. and Guzdial, M. iTell: supporting retrospective storytelling with digital photos. In *Proc. DIS '06*, ACM (2006), 160–168.
22. Lehmuskallio, A. and Sarvas, R. Snapshot video: everyday photographers taking short video-clips. In *Proc. NordiCHI '08*, ACM (2008), 257–265.
23. Miller, D. Stuff. Polity (2009).
24. Nyandeni Local Municipality. Nyandeni Integrated Development Plan: Review 2010/2011. URL: `http://goo.gl/ijTy1` (visited on 12/04/2011).
25. Oleksik, G. and Brown, L. M. Sonic gems: exploring the potential of audio recording as a form of sentimental memory capture. In *Proc. BCS-HCI '08*, British Computer Society (2008), 163–172.
26. Rangaswamy, N. and Cutrell, E. Anthropology, development and ICTs: slums, youth and the mobile internet in urban India. In *Proc. ICTD '12*, ACM (2012), 85–93.
27. Rangaswamy, N. and Sambasivan, N. Cutting chai, jugaad, and here pheri: towards ubicomp for a global community. *Personal and Ubiquitous Computing* 15.6 (2011), 553–564.
28. Reitmaier, T., Bidwell, N. and Marsden, G. Situating digital storytelling within African communities. *International Journal of Human-Computer Studies* 69.10 (2011), 658–668.
29. Reitmaier, T., Bidwell, N., Siya, M., Marsden, G. and Tucker, W. Communicating in designing an oral repository for rural African villages. In *Proc. IST-Africa*, 2012.
30. Smyth, T., Kumar, S., Medhi, I. and Toyama, K. Where there's a will there's a way: mobile media sharing in urban India. In *Proc. CHI '10*, ACM (2010), 753–762.
31. Thrift, N. and Dewsbury, J.-D. Dead geographies—and how to make them live. *Environment and Planning D: Society and Space* 18.4 (2000), 411–432.
32. Watkins, J. and Tacchi, J. Finding a voice through content creation. In *Participatory Content Creation for Development: Principles and Practices*, UNESCO (2008), 13–20.