Preserving the Ndebele dress code through the Internet of Things technologies

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ABSTRACT

The Ndebele culture, including its dress code, is at risk of being forgotten as young generations migrate to urban areas, leaving behind their traditions while adopting those that dominate the city. We propose an Internet of Things-based system to help preserve the Ndebele dress culture in a playful manner. The system requires a knowledgeable person to codify the correct combination of previously identified items of clothing and store it in the cloud. This information can subsequently be accessed from a geographically remote location to monitor the arrangement of tangible objects that represent the original pieces of clothing. We demonstrate the tangible interaction component of the proposed system by means of a single example using paper cuttings to represent the culturally correct combination of Ndebele head and neckpieces.

CCS CONCEPTS

• **Social and professional topics~Socio-technical systems** • **Social and professional topics~Cultural characteristics** • Human-centered computing~Haptic devices

KEYWORDS

Culture, Ndebele, Internet of Things, IoT

1 Introduction

The Ndebele are traditionally an ethnic group that inhabits the northern part of South Africa and the south-western part of Zimbabwe [2]. Their artistic talent is revealed in their colourfully painted houses and colourful beadwork and clothing, which attracts

a vibrant tourism industry. The origins of the Ndebele lie in the larger Nguni population that makes up two-thirds of the black population in South Africa and ten percent of the population in Zimbabwe, and with the Nguni population comprising the Zulu, Xhosa, Swati and Shangaan languages. The origins of the Ndebele lie in what was then Natal province of South Africa (now KwaZulu Natal) from where they travelled to what was previously known as the Transvaal area of South Africa (around Pretoria) and the Matebeleland area of Zimbabwe (around Bulawayo). With the influx of urbanization in search of job opportunities, the Ndebele population is leaving behind their culture and assimilating Western culture, which increases the risk of their culture dying.

Previous research have identified the importance of preserving cultures and proposed technological systems to support the preservation effort. For example, StoryBeads [8] proposes a system to preserve oral stories by capturing the voice of the storyteller and playing it back to the user at a time and place when the original teller is no longer present.

This research proposes a way to preserve Ndebele culture using Internet of Things technologies, with particular reference to the dress code of the Ndebele women. The approach is an educational and playful approach that can be adopted by both the literate and the illiterate in school, home, and museum settings. Our research is in its initial stages and has not yet been evaluated outside the laboratory. Our system is based on tangible interaction as opposed to an electronic screen-based tool. This choice is grounded in prior research ([3] is an example) that found concrete objects to be good learning devices.

The paper is structured as follows: Section 2 gives a general introduction to the Ndebele female regalia. In Section 3, we report on the technical design of the system by means of a diagram illustrating the relation between the tangible objects (including the optical sensing mechanism), the internet, the learner, and the Ndebele domain expert. The example in Section 4 is focussed on the tangible interface which requires the user to arrange cut-outs in their proper configuration. This is followed by Section 5 with a brief description of the steps a user will take when using the system. Section 6 concludes.

2 The Ndebele Female Regalia

The marital status of Ndebele women is expressed in the way they dress and the ornaments they adorn themselves with. Her faithful devotion to her husband after marriage is made visible through her ornate beadwork, her brightly coloured blankets and other trinkets. The Ndebele woman's age and social status are reflected in the colours of her beautiful dress and accessories. Two particular features of her dress code catch the eye. Around the neck, arms and legs are stacked rings. Her skirt is decorated with lavish beadwork featuring geometric patterns, tiaras, and the long strips that trail behind.

Figure 1: Ndebele women and their adorned homes.

The apron constitutes the main element of any Ndebele woman's dress as seen in Figure 1. The sizes of the aprons become bigger with age. Maidens wear small front aprons made of tassels and beads, while the elderly woman of marriageable age wear larger aprons that are traditionally made of hardened animal skin. The aprons are referred to as iphotho and are lavishly decorated with beadwork in angular geometric designs. The age group a woman belongs to is also reflected in the apron's pattern. The woman may belong to the group of mothers, may be an expectant mother or may have a desire for chastity and purity. The Jocalo is a five-panelled, beaded goatskin apron, worn by an Ndebele bride. In addition, a common element of the Ndebele woman's regalia are the idzilla. These are metal neck, ankle, and arm rings worn by married women to imitate the rolls of fat on the woman. The Ndebele culture celebrates big-sized women.

While unmarried girls traditionally go with bare upper torso with only a wide beaded collar covering their shoulders, married women on the other hand cover their upper part with blankets. The Ndebele women favour blankets with red-green and blue-yellow vertical strips. As shown in Figure 2, these blankets are also decorated with beaded panels that go horizontally to contrast the vertical stripes.

3 System Design

The system will request the user to indicate if they want to dress a mother, bride, or young girl. The system uses an optical camera to capture markers. An optical marker (also known as a fiducial) is attached to each item of clothing, and each marker is unique. We used the markers developed by the reacTable [6] developers. The Interpreter executes on a local computer. This software is written using the Processing [5] programming language and has details about each optical marker. There is a match between the optical marker and a piece of clothing. This combination is stored in a database hosted in the cloud and can be updated by persons knowledgeable about the particular culture's clothing. The Interpreter retrieves from the database the combinations that acceptable and the meanings of the combinations, for example, married woman, a bride, and virgin.
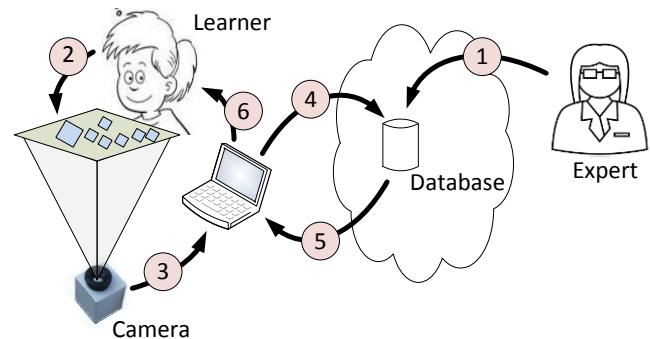

Figure 2: An Ndebele blanket.

Figure 3: Configuration

Figure 3 depicts the system components. These include a database hosted in the cloud and is populated by an expert. Populating the database requires the expert (Figure 3, Step 1) to indicate which attire combinations are valid. Once the database has been populated with the correct combinations, the learner may activate the learning part of the system. She does this by placing a picture of the woman on the construction surface (Figure 3, Step 2). The camera positioned below the construction surface transfers (Figure 3, Step 3) the unique identifier (that has previously been attached to the picture) to the Interpreter software executing on the local computer. The Interpreter then forwards the identifier to the database (Figure

3, Step 4). In turn, the database returns (Figure 3, Step 5) valid combinations of attire to match the woman. The user receives feedback (Figure 3, Step 6) based on the data retrieved from the database.

4 Example

In the example described here, a photograph of an Ndebele woman was sourced from literature [7] on South African cultures and is shown in Figure 4(a).
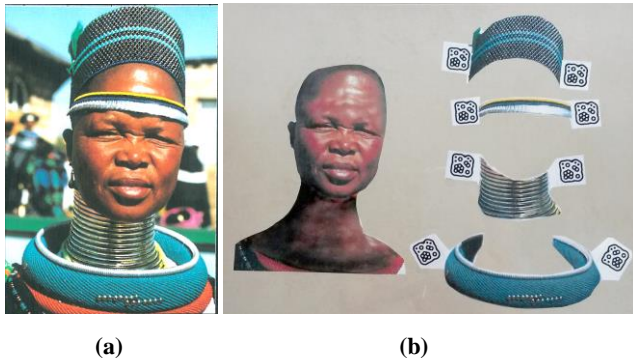

(a)   **(b)**

Figure 4: Two photographs depicting the original image (a), and the parts derived from the original, printed, and cut out by hand (b).

Using the Photoshop [1] image manipulation software, the photograph elements are decomposed into their constituent parts with these being the headpiece, headband, neck rings, and neck band. These are erased from the original image and the erased areas "filled" using image manipulation techniques such as copying colours and textures from adjacent areas in the image and then smoothing the result. The outcome is shown in Figure 4(b). Also shown in Figure 4(b) are the headpiece, headband, neck rings, and neck band extracted from the original image. Optical markers were then added to these items. The items together with their markers were then printed and cut out by hand. Two markers were added to each of the pieces using image manipulation software. The two markers on a piece are identical but differ from all the other markers on the other pieces. Finally, a marker was glued to the back of the image depicting the woman.

The markers serve as identifiers of the cut-outs, allowing the software to determine which items are on the construction surface and their position relative to the other cut-outs. In addition to serving as identifiers, the markers attached to the headpiece, headband, neck rings, and neck band can be folded back to mechanically secure the pieces in place (Figure 5(a)). Once the pieces have been attached to the image of the woman, all the markers face down and are detected by the camera (Figure 5b)).

5 Usage

When in use (Figure 6 and Figure 7), the user selects an item and places it on the optical marker recognition system. She then adds additional items in turn, each representing attire. At the same

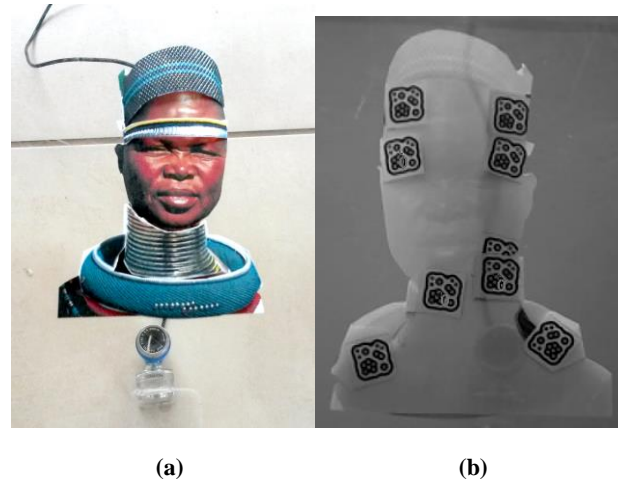time, she receives voice feedback to indicate if the items are appropriate.

(a)   **(b)**

Figure 5: Photograph of the pieces assembled correctly by the user (a), and the view as seen by the camera from below (b).

Figure 6: Setup showing the computer, camera, clear construction surface with a white frame, and supports.
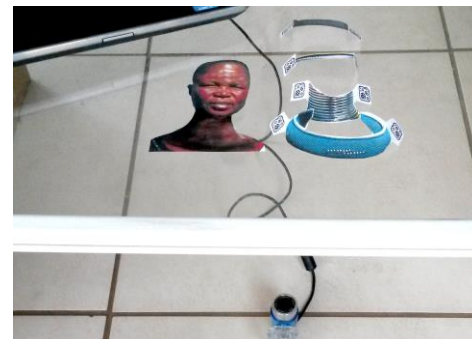

Figure 7: Photograph highlighting the position of the camera positioned below the clear construction surface. The white horizontal bar seen in the figure is the frame of the construction surface.

6 Conclusion

The Ndebele tribe (and it seems like all tribes do [4]) expresses their culture using a combination of patterns and motifs. With increasing urbanisation, new generations are leaving their heritage and tend to adopt the dominant culture in the city. The problem is that those knowledgeable about the Ndebele attire and their correct combinations do not migrate to the cities and thus the links between current and new generations are broken. Knowledge on attire combinations are therefore at risk of being forgotten. In this paper, we presented a system that may help preserve this knowledge in a playful manner. It consists of two parties; the one has expert knowledge on Ndebele attire, and the other is the learner wishing to gain new knowledge on the correct combinations.

REFERENCES

[1] Steve Caplin. 2008. *Art and design in Photoshop: How to simulate just about anything from great works of art to urban graffiti*. Focal Press, London, United Kingdom.

[2] Margaret Courtney-Clarke. 2002. *Ndebele:The art of an African tribe*. Thames & Hudson, London, United Kingdom.

[3] Demetra Evangelou, Jennifer Dobbs-Oates, Aikaterini Bagiati, Sandy Liang and Ji Young Choi (2010). Talking about Artifacts: Preschool children's explorations with sketches, stories, and tangible objects. *Early childhood research and practice*, 12(3), http://ecrp.uiuc.edu/v12n2/evangelou.html.

[4] Berenice Geoffroy-Schneiter. 2013. *Talk about tribal art*. Flammarion, Paris, France.

[5] Ira Greenberg. 2007. *Processing: Creative coding and computational art*. Apress, New York City, New York, United States of America.

[6] Sergi Jordà, Martin Kaltenbrunner, Günter Geiger and Ross Bencina. 2005. The reacTable. In *Proceedings of the International Computer Music Conference (ICMC 2005)*. ICMA, San Francisco, CA, United Sates of America.

[7] Peter Magubane. 1998. *Vanishing cultures of South Africa: Changing customs in a changing world*. Struik, Johanneburg, South Africa.

[8] Lizette Reitsma, Andrew Smith and Elise van den Hoven. 2013. StoryBeads: Preserving indigenous knowledge through tangible interaction design. In *Proceedings of the International Conference on Culture and Computing*. IEEE, Piscataway, New Jersey, United States of America. http://dx.doi.org/10.1109/CultureComputing.2013.22