Using GIS technology to document the KwaZulu-Natal battlefields

Information from the African Conservation Trust and Chris Moore

The battlefields of KwaZulu-Natal (KZN) are an important part of our national heritage as they have helped shape the province and the country as a whole. Unfortunately, many of these battlefields have in more recent years come under threat from development, neglect and vandalism. Recognising the valuable contribution that spatial technology can make in documenting important heritage sites, the University of KwaZulu-Natal (UKZN) in partnership with the African Conservation Trust (ACT) recently completed a pilot project involving the creation of a virtual archive of a globally significant battlefield.

Digital technology has proven to be an effective means for documenting national heritage for future generations as it allows for the accurate capture, analysis and preservation of history. It also allows easy access to historical information for all sectors of society.

More recently, spatial technology has made it possible to record heritage sites digitally, using geographical information systems (GIS), historical maps and GigaPan high resolution panorama technology. This has given rise to new insights into battles and new perspectives on historical events, as these technologies make it possible to re-create places and events as they were in historical time.

The UKZN/ACT study was funded by the National Lottery Distribution Trust Fund (NLDTF). Its aim was to determine whether spatial technologies could be effectively used to capture, map, analyse, and preserve the Spioenkop battlefield in KZN. The battle of Spioenkop was chosen for the study as it was a key battle in the South African War (1899 – 1902). Fought in January 1900, the futile and bloody battle was an attempt by the British to end a siege imposed by the Boers on the town of Ladysmith. What sets this battle apart from others during the South African War is that such a large number of casualties occurred in such a relatively small space.

The battlefield was documented using Global Positioning System (GPS), GIS, 3D terrain-modelling, historical analysis, and GigaPan high resolution panorama technology. These technologies allowed for the accurate documentation and visualisation of the battle through the creation of maps, virtual tours and 3D models of the battle scene, to show strategic gun positions, infantry movements and routes followed by British and Boer forces.

Fig. 1: 3D terrain model of the battlefield showing Boer and British positions and fire.

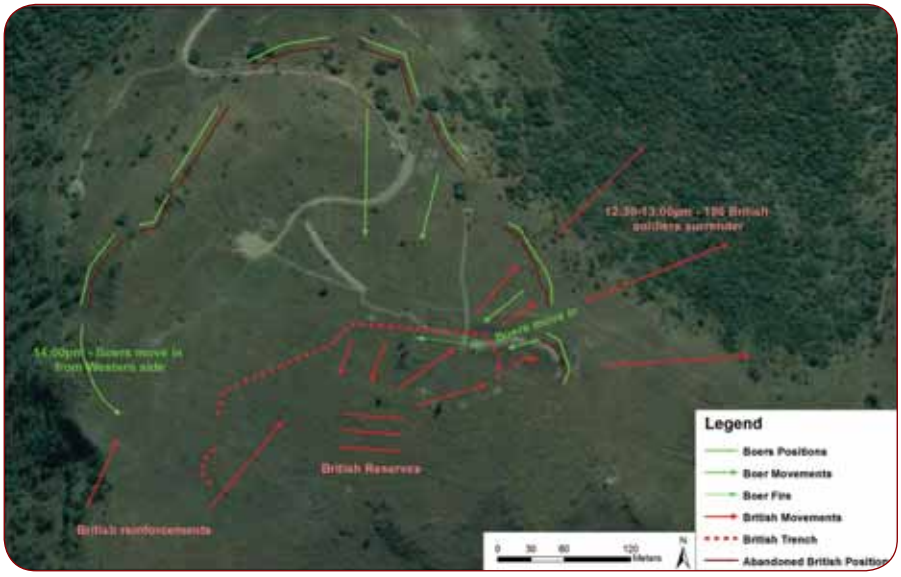

Fig. 2: Phase map depicting the movement of the battle between 12h30 and 14h00.

The project included several components. The initial component involved using Global Positioning Systems (GPS) to record what was currently on site. The exact locations of graves, memorials, monuments and trenches were recorded and attribute information, such as names

and ranks of fallen soldiers, was attached along with a photograph of each feature. These were integrated into a Google Earth layer, which allows users from anywhere in the world to explore all the features at the site and view graves individually. The layer is also easily uploaded to a website.

A process of historical mapping followed the site recordings to compare current and historical data. Historical maps were geo-referenced and superimposed on to current aerial photographs of the site. This allowed for the comparison between features drawn on the historical map and current features marked with GPS. In some instances, features marked on the historical maps did not correspond with any feature visible today. There were also features visible from the aerial photographs that were not visible on the site today nor marked on the historical map. These differences have prompted discussions among historians and will assist with bettering understanding around the exact events of the battle.

The project also involved the creation of 3D surface models for the Spioenkop battle area, which provided better visualisation of the site. The British and Boer positions and firing lines were superimposed on to the models to offer a unique view of the entire battle (Fig. 1).

Given that a battle is not a static event, it was necessary to map the various stages of battle to show key movements. After consultation with battlefields expert Gilbert Torlage, phase maps were compiled to show what was happening at different times during the battle. This allowed for more detail to be captured and visually presented (Fig. 2).

Viewshed analysis was also incorporated into the project. A viewshed is calculated in a GIS using a digital elevation model (DEM) and shows an area that is visible from a specific location, such as the peak of a hill. Viewshed analysis was used as a tool for analysing historical records of what could be seen from various key battle positions, for example comparing the orders that a general gave his soldiers with what was visible from his location at that time.

High resolution 360° panorama images were taken with a GigaPan robotic camera platform (Figs. 3 and 4) of key battle locations. The camera moves along a precise grid taking hundreds of pictures which are later stitched together to form a seamless photograph offering a full 360° field of view. The images were then uploaded and stored on the GigaPan website and the high resolution allows the user to view fine details such as names on memorials without the photograph degrading.

The final component of the study was the creation of a virtual tour (Fig. 5). The interactive web-based tool allows people from anywhere in the world to move freely around the site by linking the 360° panorama images together; simulating the battle field. Narration and written information can be added to supplement the imagery and provide more detail.

Fig. 3: Taking a high resolution GigaPan panorama image.

Conclusion

The pilot study was a great success and proved that spatial technology can effectively be used to create a comprehensive digital record of a heritage site. It also showed the digital documentation process to be a research tool for gathering more detailed and accurate information on sites that are not well documented.

Following the success of the project, the African Conservation Trust formed a partnership with CyArk (http://archive.cyark.org/); an American not-for-profit organisation that aims to digitally preserve cultural heritage sites worldwide to ensure that they will be accessible for future generations. CyArk is in the process of establishing an archive of global heritage sites through digital preservation projects. Currently, few projects exist in Africa and none in Southern Africa. ACT and UKZN have

Fig. 4: GigaPan image taken from Mount Alice.

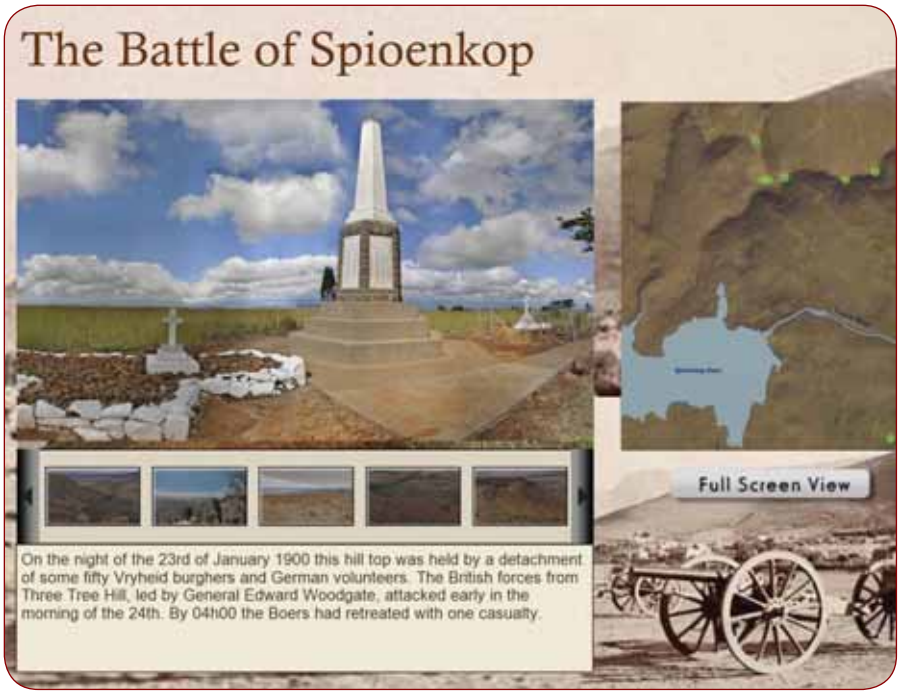

Fig. 5: The virtual tour of Spioenkop Battlefield which allows you to move through the scene and walk to different locations of the battlefield using arrows in the image or the hotspots on the map.

therefore established a CyArk South Africa chapter and are looking for further funding to continue digitally recording heritage sites and contributing to CyArk's global archive.

Acknowledgements

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- Angus Forbes (MSc.) Senior Lecturer, Programme of Geomatics and Land Surveying, UKZN.
- Carl Grossmann (MEnvDev.) Project Director, Programme of Geomatics and Land Surveying, UKZN.
- Michelle Dye (MSc.) Geographical Information Systems Specialist, African Conservation Trust (ACT)
- Chris Moore (BA) Amateur Historian and GIS Enthusiast

Amafa are the provincial heritage authority responsible for the preservation of the battlefields. It is from this formally constituted body that permission must be obtained for any research that takes place on the battlefields in KZN. We thank them for granting permission to carry out this project and for their encouragement and support.

References

Although there is now a large literature covering historical GIS, the following titles written by authors who are leaders in this field will give the reader a good overview of the discipline.

Historical GIS

[1] Ian N Gregory: Technologies, Methodologies, and Scholarship, Lancaster University, Paul S Ell, Queen's University Belfast, Series: Cambridge Studies in Historical Geography(No. 39), Publication date:December 2007.

[2] Placing History: How Maps, Spatial Data, and GIS Are Changing Historical Scholarship. Amy Hillier (Editor), Anne Kelly Knowles (Editor), ESRI Press (January 1, 2008).

[3] Past Time, Past Place: GIS for History, Anne Kelly Knowles (Editor). ESRI Press; 1st edition (April 1, 2002)

There is also a large body of work that covers the South African War 1899 – 1902 (Anglo Boer War , Tweede Vryheids Oorlog). The following book is a useful source for referencing the many publications.

[4] Fred R Van Hartesveldt: The Boer war: historiography and annotated bibliography Greenwood Press, 88 Post Road West, Westport, CT 06881 An imprint of Greenwood Publishing Group, Inc. First published in 2000.

These three major works are the standard references for the war

[5] LS Amery, ed.: The Times' History of the War in South Africa, 1899 – 1902. 7 Vols. London: Sampson Low, Marston, 1900 – 09. (The meticulous efforts of the contributors make these volumes the best place to go for details of the conflict. The bibliography is also excellent. The editor does not, however, deny his pro-British feelings, and had some personal dislike for General Buller which colours the account.)

[6] FM Maurice and MH Grant, eds.: History of the War in South Africa, 1899-1902. 4 Vols. plus maps. London: Hurst and Blackett, 1906 – 1910. (These volumes are the official British history of the war. They include very detailed accounts of military operations, but tend to shy away from controversial topics.)

[7] JH Breytenbach: Die Geskiedenis van die Tweede Vryheidsoorlog in Suid-Afrika, 1899 – 1902. [The History of the Second War For Freedom in South Africa, 1899 – 1902.] 6 Vols. Pretoria: Staats drukker, 1969 – 1996. (These volumes are the South African equivalent to the British Official History. The scholarship is meticulous and based on state records. They have, perhaps not surprisingly, somewhat of a pro-Boer bias.)

There are also a number of other more specialised titles that cover specific parts of the conflict. I produce merely a small sample of these that are relevant

[8] CJ Barnard: Generaal Louis Botha op die Natalse Front, 1899 – 1900. [General Louis Botha on the Natal Front 1899 – 1900.] Cape Town: Balkema, 1970. (Barnard analyses Botha as a military leader in the first year of the war.)

[9] Winston S Churchill: London to Ladysmith via Pretoria. London: Longmans Green, 1900. (Churchill's account, drawn from his reports to the Morning Post, is exciting and articulate. This volume covers the first months of the war including his dramatic capture and escape, and Buller's efforts to relieve Ladysmith.)

[10] E Knox Blake: Buller's Campaign. London: R. Brimley Johnson, 1902. (Knox, an RAMC doctor, provides details of medical services as well as of the campaign to relieve Ladysmith. He is not critical, either ignoring failures or dismissing them as bad luck.)

[11] Oliver Ransford: The Battle of Spion Kop. London: John Murray, 1969. (Ransford's account of the battle is detailed and thorough. He is extremely critical of Generals Buller and Warren.)

[12] Julian Symons: Buller's Campaign. London: Crescent Press, 1963; rpt. 1974. (Symons includes a great deal of background concerning the Royal Army before the war. He is critical of Buller for lack of resolution, and like many observers regards him as foolish. He does mitigate his criticism by suggesting strongly that Buller was seriously depressed, which caused his irresolution. His book is readable and well argued.)

[13] Gilbert Torlage: The Battle of Spioenkop, 23 – 24 January 1900 Randburg, Ravan Press, January 1999. (Part of a series produced for the centenary of the war)

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