

Updating a Topographical Line Map of Gaborone Broadhurst Suburb with the Help of Digital Globe Orthorectified Mosaic and Crowdsourcing

Lopang Maphale ^{a,*}, Keorapetse Moroka ^a, Mooketsi Segobye ^a, Michael B. Manisa ^a

^a *University of Botswana, maphalel@ub.ac.bw, morokakeorapetse@gmail.com, Segobyem@ub.ac.bw, manisamb@ub.ac.bw*

*Corresponding author

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Abstract:

A map produced today is immediately outdated due to continued development and changing suburban landscape patterns in cities, as such it is necessary to find ways of undertaking continuous updates of city topographical line maps. The city of Gaborone is largely recognized to be among the fast-growing cities of the world as it experiences yearly changes to its topographical formation. Ways to monitor these changes need to be ascertained to ensure that planners, surveyors and the rest of stakeholders have topographical line maps with sufficient and accurate details to aid decision-making on socio-economic and environmental interests. In case of Botswana, topographical line mapping has been updated using aerial photogrammetric methods. The method of using aerial photographs though considered to be highly accurate has its own disadvantages in that, it is expensive to perform in short term periods e.g., every six months or yearly for medium income countries like Botswana. This method is often associated with limited ranges of coverage. For these reasons, it is not surprising that the last major topographical map updates by Botswana National Mapping Agency was done in 2015. In today's fast paced development drives, this style of topographical line map updating is faced with serious temporal limitations. Another challenge when updating topographical line maps is that there is large amount of field work necessary to collect the names of features and check if the features in the map correspond to those on the ground. The motivation of this study was to advance alternatives that can be used to update topographical lines maps continuously in terms of geospatial data and place names.

In response to the foregoing, this study set out to investigate the use of Digital Globe and Crowdsourcing as techniques that can be used to undertake continuous updates of the topographical line maps that are produced by the Botswana National Mapping Agency - Department of Surveys and Mapping. To gauge the effectiveness of this approach, a Gaborone suburban of Broadhurst Topographical Line Map, Tsholofelo Area, was updated with the help of the Digital Globe Orthorectified data and crowdsourcing using the Facebook Application. The area where updates were undertaken was purposefully selected because of well-known developments which were done in the recent times. The Digital Globe Ortho-Rectified data set was used as the background for the update by obtaining the existing Topographical Line Map shapefiles from Department of Surveys and Mapping and creating an overlay. Once the existing topographical map data sets were overlaid on the Digital Globe data set in the ArcGIS environment, a prevailing scenario was obtained. The prevailing scenario clearly depicted lot of changes to the existing 2015 topographical line map of the area. Based on the existing scenario, old drawn features on 2015 map were deleted to give way to the new land cover and use configuration including features such roads, new properties, buildings and others. New features were identified and digitised from the Digital Globe Ortho-rectified data set of the selected area. It must be noted that the new developments have brought along with them new place names. Since these names were not readily known, an approach had to be devised to engage the public in establishing names for these areas. For this reason, crowdsourcing was used to interact with the public in establishing place names of the various locations and major development sites in the area. In the case of place names, the random participants were asked to state the names of a number of places which were marked by an alphabet on the digital orthorectified image. The names returned through crowdsourcing were compared and checked for repeatability and were ultimately adopted for the topographic map. Basiri, Haklay, Foody & Mooney (2019) have elaborated on qualities and biases of crowdsourced geospatial data. Despite discrepancies associated with crowdsourcing, the method was followed in this work as an overarching objective to demonstrate the utility of the employed method as summarised in Figure 1.

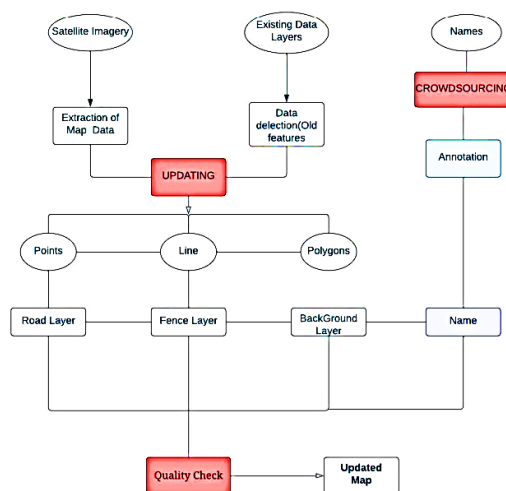


Figure 1: Summary to method followed in updating of a Gaborone Suburban Topographical Line Map.

Owing to the dynamism and constant changes in settlements locally, regionally and globally, Wagle and Acharya (2020) opines that to be reason enough to continuously track the trends and effect updates on topographical maps. For a developing country like Botswana, the constant monitoring and updating is highly important and must be undertaken. When in pursuit of these changes and associated updates, developing countries like Botswana must understand that there have been lot of developments and improvements of geospatial technologies. As such, updating topographic maps have shifted from using the aerial photos to using high resolution satellite imagery since the launching of the first commercial high-resolution satellite (Gianinetto, 2008). Using satellite images to update topographic maps offers a number of advantages in comparison to aerial photos – for instance, satellite images are multispectral hence, they can be circumspcctly used for thematic mapping. In addition, satellite images cover a wider area which means survey costs get reduced. Further, satellite images improve on accessibility so much that remote areas get easy to reach when compared to surveying them by other geospatial data collection methods. The use of orthorectified satellite images in updating topographical line maps and cadastral maps have been studied and implemented across a number of countries, e.g., Nepal (Wagle and Acharya, 2020), Pakistan (Ali, Tuladhar and Zevenbergen, 2012), Isreal (Keinan, Felus, Tal, Zilberstien and Elihai, 2016) and Onitsha City in Nigeria (Vivian, Ndidiamaka and Budi, 2019), just to mention a few. Botswana National Mapping Agency needs to get up to speed in embracing these technologies in undertaking Topographical Line Map updates.

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