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APPLICABILITY OF SMARTPHONE AS SURVEY EQUIPMENT

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ABSTRACT

Data acquisition is the core of surveying profession. The data when collected must be processed, analyzed and displayed for use. Translating hard copy field books into digital format is a tedious technique and time consuming apart from being very expensive. Besides it is also liable to errors. The sources of these errors may be human, like transposing of figures during reading or booking and such other error sources. Any system that facilitates automatic generation and loading of digital data into the database would fast track the work of the surveyor immensely. Here the mobile or cell phone comes in handy as a possible survey instrument to mitigate the challenges raised above. Owing to it electronic nature, the processes of data acquisition and entry can be merged and handled simultaneously. The smartphone is in common use among the people and often it is used as a routine and a life companion. Equipping this into a survey equipment will be a wise attempt in view of the fact that is very versatile for use. Five very important parameters were used in comparative analysis of the smart phone in relation to dedicated GPS equipment. These parameters included Cost, Convenience, Accuracy, Durability and Battery life. For the first three parameters, the smart phone took the lead. For the latter two, the dedicated GPS was the choice. However improvements in modern phones have tended to give the smart phone the edge. In this research, the smartphone was employed in the execution of base line measurement and cadastral surveys. From analysis of results obtained, minimum requirements for obtaining acceptable accuracies were established. In summary, it is safe to say that smart phone can complement and even at times replace the dedicated GPS in view of its numerous advantages over dedicated GPS as established by this research.

Keywords: *Data acquisition, Automatic Generation, Transposing, Transcribing, Cell Phone, Cadastral Surveys*

INTRODUCTION

Data acquisition is the core of surveying profession. The data when collected must be processed, analyzed and displayed for use. Translating hard copy field books into digital format is a tedious technique and time consuming apart from being very expensive. Besides it is also liable to errors. The sources of these errors may be human, like transposing of figures during reading or booking and such other error sources. Any system that facilitates automatic generation and loading of digital data into the database would fast track the work of the surveyor immensely.

Here the mobile or cell phone comes in handy as a possible survey instrument to mitigate the challenges raised above. Here owing to it electronic nature, the processes of data acquisition and entry can be merged and handled simultaneously. Before now, electronic data capture was executed using handy devices like PDAs but nowadays newer and more powerful Smartphones abound in the market and this creates high opportunities for the replacement of PDAs with smart phones. This is also favoured by the current advances in technology and availability of specialized software on these Smartphones. This research examines the benefit of using this platform as a veritable survey equipment of data capture and transmission on the fly.

REVIEW OF LITERATURE

It has been reported from research that mobile phone has been used in the capture of data for survey of household in some African countries (Tomlinson *et al*., 2009, Schuster and Broto, 2011, Jefffrey *et al*., 2010, Rajpat *et al*., 2012). Without doubt this approach consumes less time and it is also user friendly as it affords access to data in real time. In addition data integrity is maintained as quality control is assured through close monitoring of field survey officers. This is also cost effective and speedy.

It has been shown by Aanensen *et al*., (2009) that cell phones are useful in data collection for study and display of epidemics and also in the ecological disaster management and control. Their application have been used by WHO, World Bank and a variety of International Programs.

The Global Pulse and MobileActive.org developed a repository of projects showing mobile phone data usages.

In the same vein, The West Coast Horsemen Magazine (2015), gave a comparison between GPS and Smartphones for Trail Riders and showed that smartphone was the preferred choice. Five factors were considered and they included Cost, Convenience Accuracy, Durability and Battery life. For Cost, the Smartphone was the preferred because most people nowadays already have smart phones with them always and installing the App for survey would not be a challenge. For Convenience, Smartphone also beats dedicated GPS owing to the availability of multiple mapping Apps for smart phones along with available free updates.

In terms of Accuracy, the Smartphone takes the lead as they use both the GPS and GLONASS simultaneously ensuring quicker acquisition of satellites.

For Durability, the dedicated GPS takes the lead. For battery life, it is been shown that the smartphones consumes more power than dedicated GPS which are designed to optimize power. However with the advances in Smartphone technology, these issues about battery and durability have been resolved with provision of power banks and more rugged brands.

PHONE BASED DATA COLLECTION PRINCIPLES

The principle employed here is simple using the software of mobile topographer, the data is collected by simply putting on the location function on the phone and mobile data usage is not necessary. The data can be acquired and electronically stored and transmitted from the phone when required. The spatial coordinates of points are acquired, the multimedia dataset are also captured using the camera and video also available on the smartphone. These datasets include the photograph, the audio narration, the video clips and even text. The data so acquired can be shared between phone sets using different operating systems. They can be moved or shared between one or many cellphones and collated on a web – based database which can then be manipulated, processed and analyzed.

Apart from the advantages highlighted earlier, the following advantages can be added:

Affordability and Environmental friendliness.

The existing methods of data capture requires printed forms for booking as in field sheets. These have to be transferred into spreadsheets or other packages. This requires expenses in terms of paper purchase, typing and printing. In mobile - based data collection system, these costs are saved since collected data can directly be sent to database. No special data collection module is required; and usage of cell phone is a routine among most people. This advantage is highlighted by (Rajput *et al.*, 2013, Global Pulse Inventory and Calculate Carbon Savings and Money Savings, 2013). The later also added saving in form of money, carbon emission and trees as can be seen in http://www.doforms.com/saving.

Speedy and Accurate Reporting.

Data can be transferred as soon as it is acquired and hence permits prompt analysis and sharing of information. Little or no error is seen when transcribing owing to adequate checking mechanism.

Possibility for multimedia data capture.

Mobile phones are veritable data capturing instruments for any entity of interest. They allow for collection of all multimedia contents in addition to the spatial elements. No special training is required.

LIMITATIONS

For effective usage, it is required that the user must be familiar with the operating protocol of the phone in question in order to minimize error possibilities. This is mainly typographic. Data entry accuracy has quantitatively be evaluated by Patnaik *et al.*, (2013) per datum to be 4.2% for electronic forms, 4.5% for SMS (short messaging services and 0.45% for voice. The challenges of maintenance of battery life in remote areas is a case to be taken seriously. Phone theft and snatching is a regular occurrence to be contended with. The phone is subject to malfunctioning and the break in network connectivity cannot be overruled in developing countries like Nigeria and this can hamper data sharing or transmission. However data can be securely stored in the phone and transmitted when there is improvement or availability of connectivity.

ACCURACY CONSIDERATION

The accuracy of survey operations is measurable with reference to the accuracy of the control pillars used, the length between survey points (length of individual legs), the total length of the traverse and the closing errors in both Northing and Easting.

Based on these parameters, the applicability of smart phones as survey equipment was tested.

AIM AND OBJECTIVES

The aim of this research is to develop an approach to test the applicability of smart phones as veritable survey equipment based on the accuracy criteria of certain survey works.

THE OBJECTIVES INCLDUED

i. To measure the coordinates of baselines at varying degrees of accuracy
ii. To carry out cadastral survey of plots of land of different total distances at different accuracy levels
iii. To compute the linear accuracies of the surveys and determine conformity with the set standards.

METHODOLOGY

The survey pillars i.e. OSGoF pillars XSP 70 and YSP 11 were used as a baseline and the coordinates of this line were measured at both ends. These pillars are respectively located at the secretariat of Igalamela/Odolu and School of Environmental Studies, Federal Polytechnic, Idah. The values observed were recorded, processed and analyzed. Further, cadastral survey of plots of land were executed at various levels and sigma distances and computed for the linear accuracy and analyzed.

RESULTS AND DISCUSSIONS

The error levels considered varied from 0.02m in Easting and Northing to 0.10m. For the baseline measurement, at the error level of 0.04m; over the length of 3000m an accuracy of 1/53000 was achieved. For an error level of 0.02m and sigma distance of 200m, the accuracy level was 1/7000. This entails that the readings of the instrument must be about 2000 times to be able to have this error and accuracy level and it also depends on the length of time the instrument was engaged non- stop. For sigma length of less than 200m, say 100m, the accuracy was 1/4000 which is less than the specification for cadastral or third order job in Nigeria hence not suited for use. For error of 0.03m, the minimum sigma length of traverse must be 200m and this gave a linear accuracy of 1/5000. This implies that the sigma length under this error class must not be less than 300m.

For an error of 0.04m, the approximate sigma length must be 300m to be able to give a linear accuracy of 1/5000. For error level of 0.05m, the minimum sigma length of traverse must be 400m for the linear accuracy of 1/6000.

The error level of 0.06m has a minimum sigma length of 400m yielding a linear accuracy of approximately 1/5000.

The error level of 0.07m has a minimum sigma length of 500m, while 0.08m error level has sigma length of 600m producing the linear accuracy of 1/5000. 0.09m error level has minimum sigma length of 600m with approximate linear accuracy of 1/5000. Finally 0.10m error level has minimum sigma length of 700m, with a linear accuracy of 1/500.

For works having higher sigma lengths, the accuracy is improved, that is, the higher the sigma length, the higher the accuracy even at higher error levels. For example at the error of 0.09m and a sigma length of 1200m, the accuracy is 1/9000. For the error of 0.10m and sigma length of 1400m, the accuracy is approximately 1/10,000. For the error of 0.03 and sigma length of 400m, the accuracy is above/approximately 1/9000. This implies that error and accuracy are inversely proportional. This is shown in table I below. In summary, it is safe to say that smart phone can complement and even at times replace the dedicated GPS in view of its numerous advantages over dedicated GPS as established by this research.

TABLE 1.0 SHOWING ERROR, MINIMUM SIGMA LENGTH AND ACCURACY LEVELS

ERROR	SIGMA LENGTH (Σ L)	ACCURACY
0.02	200	1/7000
0.03	200	1/5000

0.04	300	1/5000
0.05	400	1/6000
0.06	400	1/5000
0.07	500	1/5000
0.08	600	1/5000
0.09	600	1/5000
0.10	700	1/5000

Source: Author

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