Journal of Psychology and Political Science
ISSN: 2799-1024
Vol : 04, No. 01 , Dec 2023-Jan 2024
http://journal.hmjournals.com/index.php/JPPS
DOI: https://doi.org/10.55529/jpps.41.1.9

Developing a Unique Identifier of Smallest Possible Ballot Area that Create One-One-Match with Voting Unit Identifier for Efficient Election Management in Jos South LGA Plateau State, Nigeria

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Received: 21 August 2023 **Accepted:** 07 November 2023 **Published:** 22 December 2023

Abstract: ***The in-efficient approach adopted in managing election data by the Election Management Body (EMB), coupled with none-application of Geographic Information System (GIS) resulted into series of election fraud, particularly in the 2023 general election and the recent off-season governorship elections in Kogi, Bayelsa and Imo States in November 11th, 2023. That is why this article aimed at using GIS in developing unique identifier for the smallest possible ballot area that create one-one-match with voting unit identifier, in order to effectively manage election process. That is why, developing a unique identifier of smallest possible ballot area that create one-one-match with voting unit identifier for efficient election management is so generic, particularly when establishing a geo-spatial election database. A Geo-Relational Database Management System (GRDBMS) on MySQL format was developed after a detailed study data needs assessment which provides a 'strong entity relation' table. The result at prompt of ArcGIS using 'Polling unit' as the Strong Entity (SE) revealed in tabular format showing one-one-match voter. That is, each voter is designated a specific ballot point, name and address geo-coded and other bio-metric characteristics in spread sheet. This indeed enable the Independent National Electoral Commission (INEC) to effectively plan for election and be the owner and custodian of election fundamental datasets for election planning processes.***

Keyword: Strong Entity, MySQL, GRDBMS, Owners/Custodian, ArcGIS and Polling Unit.

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1. INTRODUCTION

One of the cogent steps advocated for by the 'Best Practice' in 2019 artjcle of ge-enable election was to develop a unique identifier of smallest possible ballot area that create one-one-match with voting unit identifier for efficient election nanagement processes. This was as a result of the frequently asked question by the eligible voters on 'Whether or not, the election umpire (INEC) can identify each voter with unique polling unit identifier'.

The researcher was a witnessed to a MoU signed by INEC to collaborate with the National Population Commission (NPopC) in the year 2015 during the nation-wide Enumeration Area Demarcation (EAD) using Geographic Information System (GIS) and Remote Sensing (RS) for the collection of Census and Housing fundamental datasets and sub-sequent analysis. Unfortunately, INEC could not fullfil her own side of the aggrement, so she opted out. The NPopC file geo-database would have served as a generic data for effective planning for free, fair and credible election, devoid of controvercies and litigations.

The last 2023 governorship election result in Kano State, Nigeria was turned down by the court for non-stamped and signed ballot papers by the INEC staff of some polling units, amounting to 146,000 ballots as reported by 'The Punch News Paper', Nov, 2023.

Furthermore, YAGA Africa, 2023 report in all Nigeria and International media houses election aberrations that took place during the off-season elections in Kogi, Bayelsa and Imo States; whereby election results have been written and signed by INEC staff in Kogi State wjile accreditation of voters were still on-going in various polling units across the state. While in Imo State, The National Chairman of INEC, prior to the election announced October 31st, 2023 that, some numbers of Electoral Wards in four (4) LGAs of the state shall not part-take of this election. But on announcement, the incumbent governor (Hon. Hope Uzodinma), won in all the twenty-seven (27) LGAs including where election never took place.

This a clear revelation that, the election umpire (INEC) cannot identify uniquely her eligible voters and their unique polling units, not to talk about having a geo-spatial election database. It was against these background that, this article seeks to develop a unique identifier of smallest possible ballot area that create one-one-match with voting unit identifier for efficient election management in Jos South LGA Plateau State, Nigeria as proto-type

2. MATERIALS AND METHOD

2.1 Materials

The GIS data need for this study are in two folds namely; the hard copy (secondary data) of names of existing polling units from Independent National Election Commission (INEC) and their corresponding locality names of the twelve (12) Wards of the area under investigation, then the aggregate number of wards per electoral constituency/district; and soft copy of file geo-database of Enumeration Area Demarcation (EAD) of Jos South LGA from National Population Commission of extracting INEC Registration Area (IRAs), locality boundaries,

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residential houses with their attributes such as addresses, routes and essential service data. The coordinates of all existing polling units were obtained during reconnaissance survey (i.e., Primary data) at an accuracy of ±2meter radius.

2.2 Method

Both primary and secondary data including the coordinates of polling units (PUs) obtained, an assessment of user's need was carried out in order to ascertain actual data needs based on the exigency of spatial location of objects and their attributes. At the end of the assessment study, a master data list was prepared summarizing all the different types of data needs into three sub-headings namely: 1 A master data list, showing all the geographic data set and their attributes as required. See table1 below, list of master data needs.

Table 1: Master Data List

Entity	Attributes	Object Type
State boundary	St name, st id, st lga, st totpop, st_IRA, st_PU	Polygon
LGA boundary	Lga_id, lganame, lga IRA, lga PU, lga Pop	Polygon
INEC Reg Area	IRA id, IRA name, IRA_PU, IRA Pop	Polygon
Locality	Loc_id, loc_name, loc_IRA, loc_PU	Polygon
Polling Unit	PU_id, PU_name, PU_IRA, PU_loc, PU_Reg_Voter	Point
Building	bld_id, bld owner, bld address, bld type, bld+hh, bld_IRA	Point
Voter	vt_id, vt name, vt bld_addr vt_IRA, vt_PU, vt_loc, Vt_bio metric	Text
Registration Centre	regra_id regra_name regra_type regra_loc regra_IRA regra_loc, regra_PU	Text
Super Admin	Adm_id Adm_name Adm_Status Adm_State Adm_LGA	Text

Source: Author's Field Work (2023)

Then the type of application required per type of data and operation in order to achieve standard and and desired accuracy. This is pertinent because it provide clue to the cost of operations, appropriate location of voting point and expert (s) required. See table 2 below.

Table 2: Required Application

App. no.	Application Name	Type	Frequency
1	INEC Registration area query	Query and display	daily
2	Polling Unit query	Query and display	8/day
3	Voting Point query	Map analysis	67/day

Source: Author's Field Work (2023)

Geo-relation dabase management system (GRDBMS) in hierarchical format that is predicated on MySQL was adopted for ease of integration at prompt and eventual analysis: thus; the thirty-six (36) states in Nigeria and Abuja (FCT); and each state has a unique identifier, a name and geographic location. A state controls a number of local government areas, each

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with unique identifier, name, location; and each LGA has a number of districts, each with unique name, a unique identifier and number, geographic location; each district with specific number of electoral wards with unique identifier, name, location and specific number of polling units. Each Ward has a name, number of polling units with unique identity, unique identifier of each registered voter; and each polling unit has a number of buildings of voters with unique identifier, address and location (geo-coded), name, birth-date, and bio-metric and appropriate voting point identifier. A voter is assigned to one polling unit (voting place or location). All of these are existing in each locality; each locality has a name, unique identifier, a number of polling units (Voting place or location) with their unique identification, building unique code, routes, drainages, police out-post, health centers, schools, etc. The assigned polling unit (voting location), is usually within trekkable distance from usual place of residence. But there is the need to record the birth date of Nigerians in each voting area, in order to keep track of potential voters of each polling unit. Each potential voter has a name, birthday which can be related to a polling unit.

3. RESULT AND DISCUSSIONS

Output 1

One-One-Match Entity Relation Database

The entities that is holding or connecting specific information (i.e. data in each table or entity) and their integration or relationships) was as shown in figure 1 below;

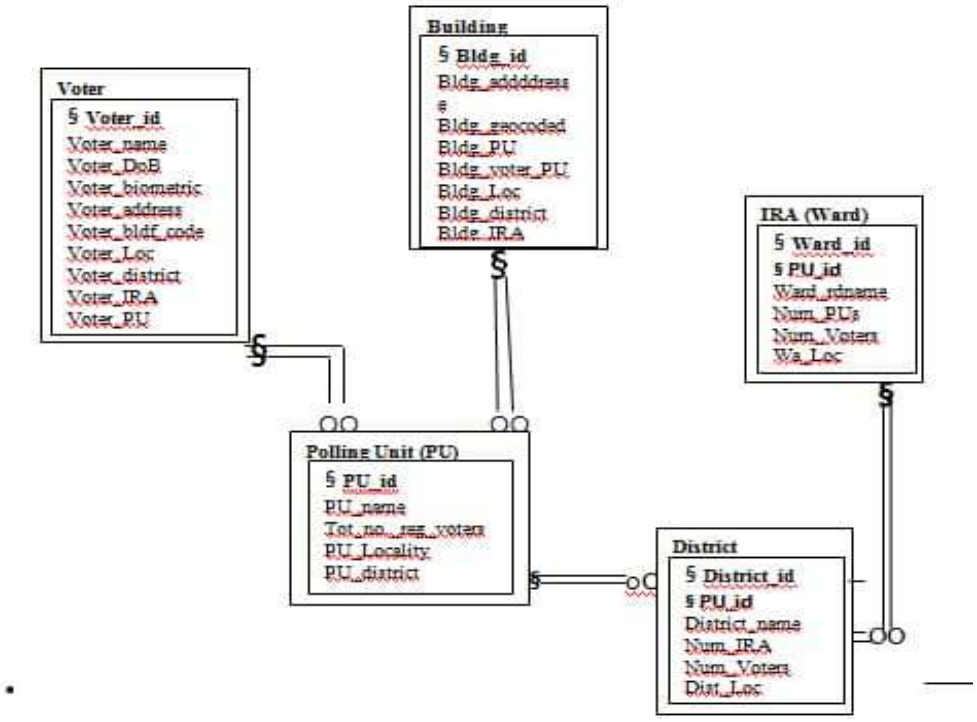

Figure 1: Entity Relations of one-one Match Voter

Source: Author's Field Work (2023)

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The above schema is the graphic expressions of the implicit operations at prompt of GRDBMS of ArcGIS in ArcMap..

Output 2

One-One-Match Voter (Pollinng Unit): Strong Entity

Any table without a foreign key or a table with a foreign key and null, is referred to as a strong entity; because it is the collection of similar entities that defines the type (s) as exemplified in the election tables and their attributes database above. The primary key is the Vt's_id and it become a foreign key in the PU table. While, a candidate or composite key is the first or last name of a voter that uniquely identify or distinguish one voter from the other, if there is no coincidence of names; better still, date of birth (DoB) of a voter vary, it is not too common to have two or more voter (s) with the same DoB.

The primary key (§) was derived from the primary key of the parent entity (Polling unit or voting point). Of course, without a corresponding voter's records (from the polling units or voting points), the Ward records would not exist; and for this analysis, the main entity is POLLING UNIT. This is because, all eligible voter can only VOTE in a designated polling unit. Therefore, an entity is considered strong if it can exist on its own apart from all of its related entities. See figure 2 below:

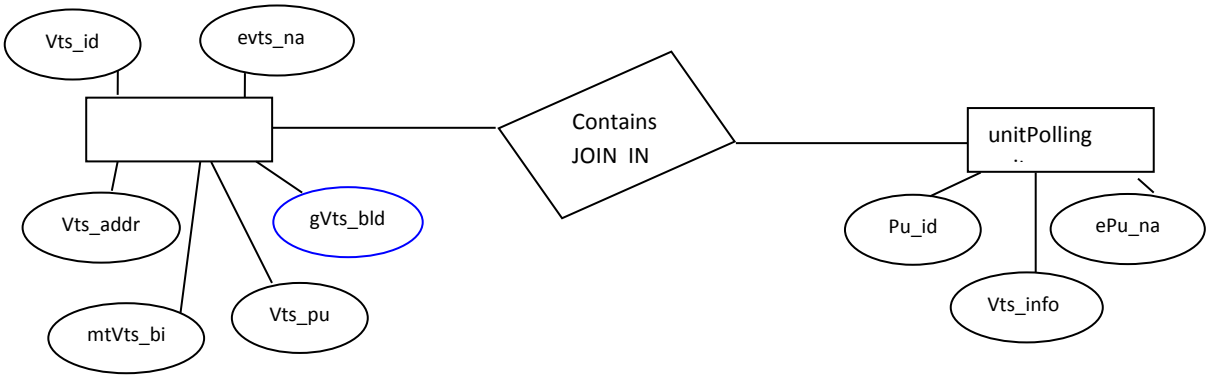

Figure 2: Strong Entity Relations of one-one Match Voter

Source: Author's Field Work (2023)

Figure 1 above is a one to many (I to M) entity relationship; that is, a polling unit to many voters. One polling unit serves or houses data of at least one thousand to one thousand five hundred eligible voters (1000-1,500) as specified by INEC.

Output 3

One-one-match Unique Identifier System

The one-one-match is as shown in figure 3 below. Each voter with a unique identifier, matched with the voter's building identification (bldg_id), vt's_pu. Here, the voter's building id was as shown in figure 1 above geo-coded numerically (uniquely), then a unique identification was generated for the nearest polling unit closest to that voter's usual place of

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residence and the voter's unique identification. Therefore, in a one-one-match voting system, a voter has at least a fifteen (15) digit numeric code, since a polling unit has at least between 1000-1500 registered voters and were derived as follows (00 000 00 00 00 0000):

1. The first two digits from the left is the state code, which is Plateau (16), derived serpentinelly on the map of Nigeria starting from the extreme top left of Sokoto State. 2. LGA code (330) that is Jos South; was derived using the same order above. 3. District code (01). The area under investigation has four (4) districts starting from the extreme left, which is Du to the last.

4. Polling unit code (01), also in serpentine order beginning from the first building of eligible voter (s). 5. Building code (1.....n^x), also in serpentine order. 6. Voter's identification code was derived from items 1-5 (163300101110000).

Table 3 below was extracted as sample a from the Geo-Relational Database Management System (GRDBMS) on MySQL format for the 'Strong Entity' Polling Unit (01) of the study.

Table 3: Sample of One-One-Match Voting System (PU GRDBMS)

St name	St id	Lga name	Lga id	Dist name	Dist id	Pu name	Pu id	vt's name	Bldg. id	vt's id
Plateau	16	Jos South	330	Du	01	Bukuru	01	Gyaha	1	16330010111
Plateau	16	Jos South	330	Du	01	Bukuru	01	John Agwu	2	16330010122
Plateau	16	Jos South	330	Du	01	Bukuru	01	Sam Bitrus	3	16330010133
Plateau	16	Jos South	330	Du	01	Bukuru	01	Aliyu Sanda	4	16330010144
Plateau	16	Jos South	330	Du	01	Bukuru	01	Ken Chike	5	16330010155
Plateau	16	Jos South	330	Du	01	Bukuru	01	Nuhu Yusuf	6	330010166
Plateau	16	Jos South	330	Du	01	Bukuru	01	Barnabas Dalyop	7	30010177
Plateau	16	Jos South	330	Du	01	Bukuru	01	Augustin Orinya	8	16330010188
Plateau	16	Jos South	330	Du	01	Bukuru	01	Longs Jagabs	9	1633001099
Plateau	16	Jos South	330	Du	01	Bukuru	01	Okoro Patience	10	1633001011010

Source: Author's Field work (2023)

Figure 3 below revealed the implicit workings of thegeo-relational database on MySQL for one-one-match voter in a designated polling unit.

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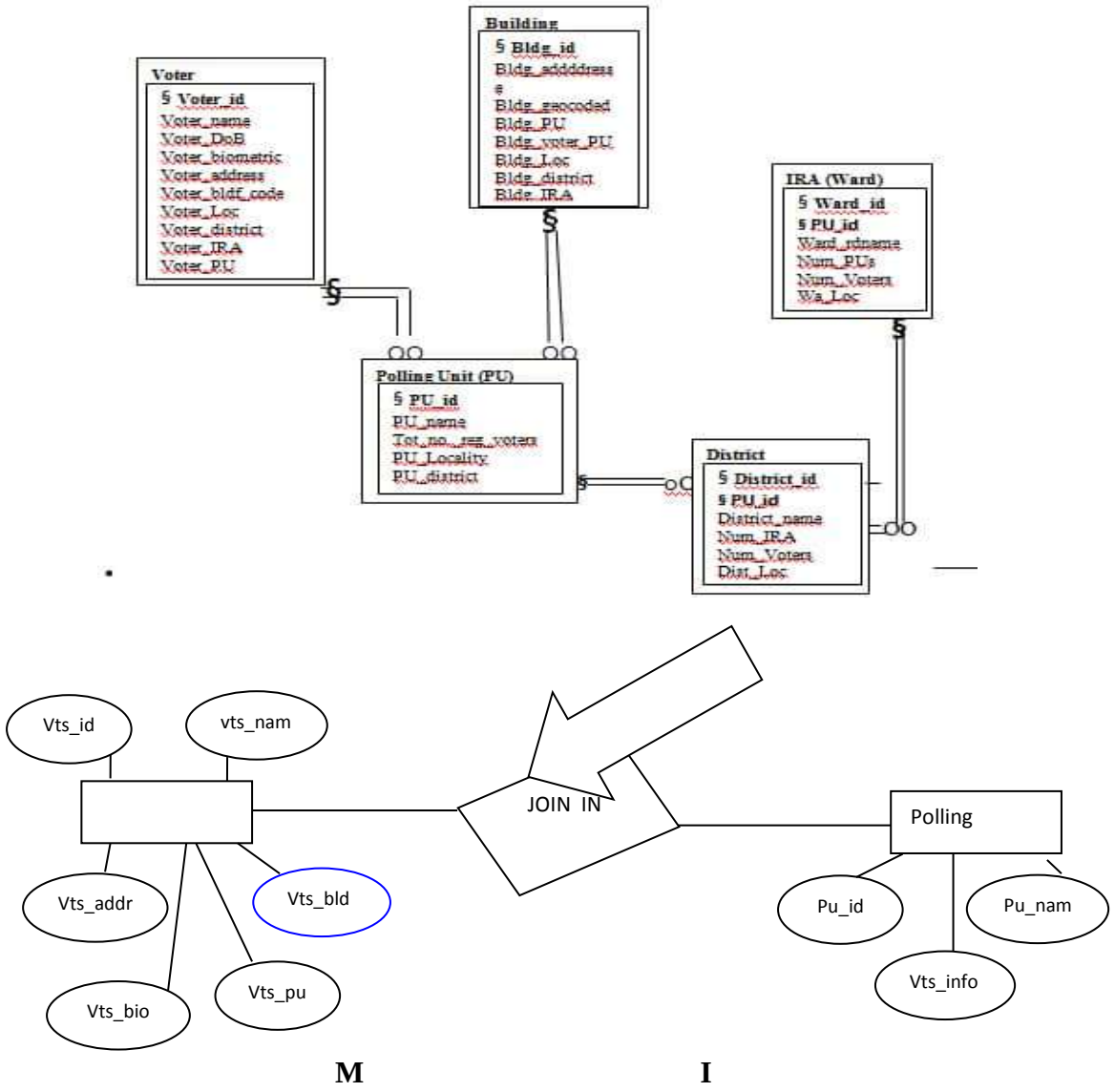

Figure 3: Summarized One-One-Match Voter Unique Identifier
Source: Author's Field Work (2023)

4. CONCLUSION

In order to develop a unique identifier of the smallest possible ballot area that creates a one-to-one-match with voting unit identifier, a GRDBMS on MySQL format using a strong entity, which is polling unit being the point at which any eligible voter exercises his or her civic right on Election Day (ED) was created and demonstrated in the form of heirachy based on data needs.

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The database 43vealed how each entity are connected to each other with a unique identifier by their primary keys from St_id to Vt_id in a unique Pu_id. All these are stored implicitly in the form of quard-tree at the ArcGIS file geo-relational database. See figure 3 above.
The one-one-match voting sys as demonstrated shows that, election maleficient of different types experienced in the study area would be reduced drastically. This is because the system will not allow multiple voting or a non-nigerian not known in the election database to vote.
The Election Management Body (EMB) now have access to robust database for ease of standard, data exchange and integration, update voter's information and re-delineation of new or additional constituency and develop metadata.
It implies that INEC and staff would have to develop capacity and hire GIS professionals to assist in establishing a robust database and in-house training in the use of the technology for efficient election.

Compliance with Ethical Standards

Acknowledgments
I acknowledged the encouragement and impartation of knowledge from Prof. F.I. Okeke who meticulously guide and counseled me while writing this article.

I cannot forgt Dr. Raphael Ndukwu of the University of Nigeria, Department of Geo-Informatics and Surveying for his professional contributions and ethics in the cause of writing this article.

My gratitudes to Dr. C.F.F. Tanimowo (Ph.D Economics, Manchester, UK), who single handedly bore the burden of payment for the publication of this article. I remain always grateful for the sacrifice made.

Mubarak, Umar Faruk (Ph.D in view) of the University of Jos, Department of Geology and Mining, who made himself available at all time to critic the article based on his wealth of experience.

I deeply appreciate the immense contributions of Yusuf, Ibrahim Kuriwa (Ph.D in view) of the University of Jos, Department of Geology and Mining, for taken his time by ensuring that, the lay-down steps as provided by this Journal was strictly adhered to without omission.

The contributions of Mary James (M.Phil in view) of the University of Jos, Department of Linguistics, remain indelible. She took her time going through the knitty-gritty of the article, that is for logicality and concept.

Disclosure of conflict of interest
The authors declare that they have no known competing financial interest or personal relationships that could have appeared to influence the work reported in this paper.

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