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Integration of GPS and GIS in Mapping of Secondary Schools in Akure South Local Government Area of Ondo State Nigeria

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ABSTRACT: The study aims at integrating GPS and GIS in the Mapping of secondary schools in Akure South Local Government Area of Ondo State with a view to identify, map, and create a database for both private and government secondary schools within the study area. A total number of 56 schools were identified. Garmin Map 76CSX hand-held GPS was used in acquiring their positions (coordinate in Eastings and Northings) within the study area while the attribute data was obtained from the ministry of education. The satellite image of the study area was downloaded from Google Earth website. ArcGIS 10.1 was used for the production of the digital map while Microsoft Access 2007 was used in generating the database. In performing the query, the query builder in ArcView was used. The result of the database reveals that the number of secondary schools owned by the government and private individuals are 26 and 30 respectively, representing 45% and 54% respectively of the total secondary schools within the study area. The created database reveals that some schools have complete facilities with specific laboratories for each of the science subjects while others have incomplete equipment or lack specific laboratory facilities for practical subjects. Furthermore, the study reveals that there are more private schools than government owned secondary schools within the study area.

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Surveying and mapping are the core values of all infrastructures and socio-economic improvement of all countries. Hence the significance of this sector cannot be over-emphasized. For this reason, any reasonable development should always give surveying and mapping a great priority for the effective, accurate, and efficient development of any nation (Aliyu *et al*., 2013). Geographic Information System and Digital Mapping is a tool that can be used in solving and answering most of the problems in the educational sector even in environmental problems. Geographic information system (GIS) comprises hardware, and software, to manage, manipulate, analyze, model, plan, and produce the desired result (NCGIA, 1991). The method used in producing a digital map depends on the mode of data acquisition either the ground method or the Remote Sensing method in which the quality of the data will determine the output of the map. GIS approach is been used even by non-Geographic Information System (GIS) experts to resolve most of the locational and decision-making policy in their daily activities (Bukhari *et al.*, 2013). GIS provides planners, surveyors, and engineers with the tools they need to design their cities/towns. Urban utility and facility developers as technical expertise in fiscal understanding to transform a vision of tomorrow into a strategic action plan for today, have to use GIS just before facilitate the decision-making process (Anavberokhai, 2008). The Global Positioning System (GPS) technology has come to revolutionised surveying profession, especially in the area of position fixing. It is a satellite-based system for rapid determination of position fixation practically on the earth (land, air, or sea) and at any time with pinpoint accuracy. The latest technology uses a specialized radio receiver called a GPS receiver. It is designed to detect radio signals transmitted from satellites and calculate positions based on such signals. Receivers intended for geodetic surveys have better accuracy and have an interface that allows rapid data collection. The Global Positioning System (GPS) has absolutely modernised the field of surveying. This system has so many applications in various fields ranging from geodetic positioning, control densification, hydrographic surveying, mining surveying, etc. The main benefit is in the economy of time and labor, culminating in the reduction of project cost (Idowu, 2003). GPS is a space satellite system that provides accurate information (altitude, bearings, and coordinates of points in absolute terms in three dimensions) to all users. These coordinates which are either rectangular coordinates (X, Y, Z) or geographical coordinates (φ,λ, h), plus other quantities of interest are referenced to a particular ellipsoidal datum, the WGS84 datum. According to Adediran, (2013) this study reveals that the ever-increasing population of secondary school students in Nigeria had brought in various problems, with which the schools cannot cope. The intensity of these difficulties among students should be a major concern for any educational

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sector of a developing nation, knowing full well that education is the key to a successful country. If more priority is placed on education, most of the issues that bring discouragement to students in the learning environment will be a talk of the past. Olubadewo (2013) as cited by Tijjani (2014) also states that several studies have examined positional forecasting and their related penalties on the accomplishment of students in several states of the Federation. The study on mapping school facilities and analysing them can show the distribution pattern, which could be clustered, dispersed, or randomly and to see whether the amenities serve the people of the area. Integrated GPS/GIS can also be used by planners for the design of telecommunication lines, water supply lines, and transportation routing as part of the service providing. Also, GIS offers the opportunity to assess these utilities were planning and automate time-consuming processes especially the ability to optimize the output regarding quality, documentation, visualization, and time (Kaousias, 2004). Finalizing this accessibility to education at all levels helps to equip people with the potentials to overcome the constraints to development (Denga, 2000). A GIS database created can support the decision-maker's inappropriate distribution of schools, improve the existing structure, and provide more additional infrastructures for preparation and management of educational resources (Idowu, 2012). The application of GIS in spatial planning support tools has an advantage through changing the valuation standards to visually illustrate and depict where the implications of different spatial decisions and alternatives are convenient. The capabilities needed for decision-making readily available in a single system making GPS/GIS a great tool integrating into planning processes (ESRI, 2011). Hence, Oghenechuko (2014) explains a database as a collection of several related data files. Database management is a collection of software for creating, storing, manipulating, updating, organizing, and querying information in a database (Kufoniyi, 1998). Therefore, GPS/GIS integration will provides the appropriate method of Mapping and analyzing the spatial distribution of educational facilities within the study area.

Study Area: Akure South Local Government Area in Ondo State, Nigeria, is located along latitude 7^0 5'N to 7^0 20" N and longitude 5^0 5'E to 5^0 20'E.

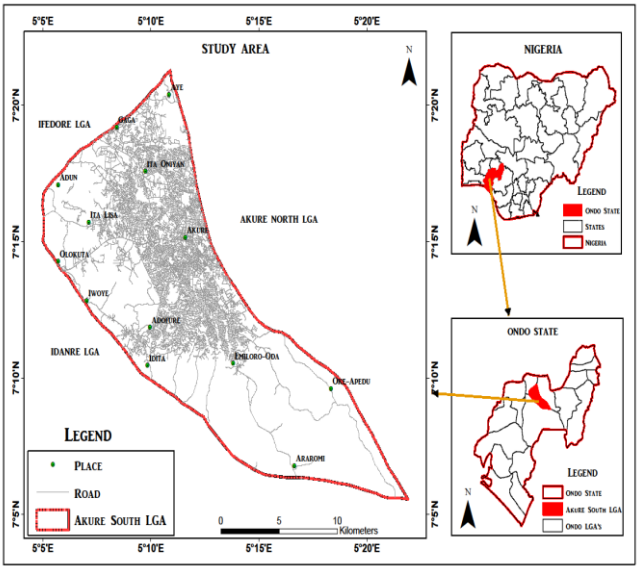

Fig 1: Map showing the study area. (Author, 2021)

MATERIALS AND METHODS

Materials: The data collected for this study was acquired from both primary and secondary sources. The primary data are the point coordinates of the secondary schools located within the study area. These coordinates were obtained using a handheld Germin Map76cxs Global Positioning System (GPS) receiver. The secondary data are the satellite imagery, administrative map and the attribute data. The satellite imagery of the study area was downloaded from Google Earth and two different procedures were adopted in capturing the imagery. This includes using Elshayal Smart GIS, and serving the image in premium on Google Earth. The administrative map was scanned, geo-referenced, and the thematic features such as road network, political wards boundary, and other existing infrastructures were extracted using on-screen digitizing. GPS coordinates of secondary schools were properly geo-coded and integrated into the ArcGIS database. Attribute data was obtained from the Ministry of Education, Ondo State.

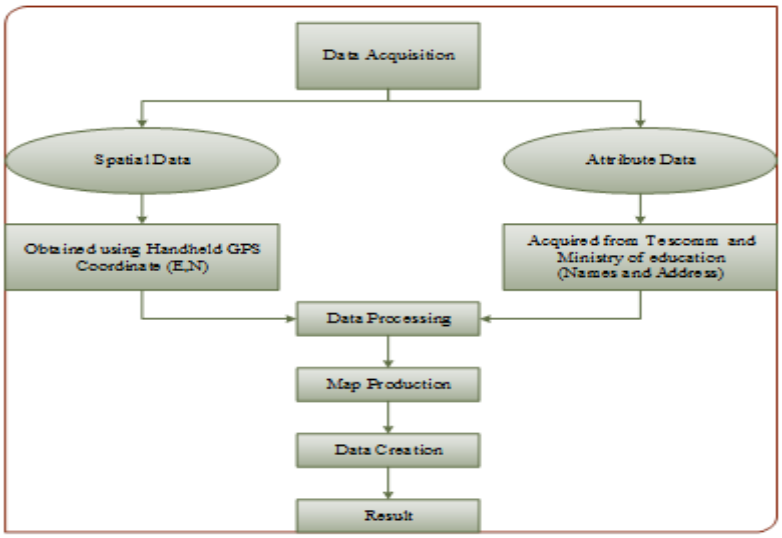

Fig 2: The study methodology flow chart

ArcGIS 10.1 software was used for the production of the digital map while Microsoft Access 2007 was used in generating the database and carrying out the query.

Spatial and Attribute data Acquisition: The spatial data acquisition for this study involves the use of handheld GPS in obtaining the coordinates (X and Y) of each position of the school within the study area. The imagery downloaded from Google Earth which served as the base map was captured using two different procedures. The first involves using the Elshayal Smart GIS software to capture the image in bits until the entire area is covered; and then the whole captured imagery is mosaic together. This step produced a rectified image of the study area. The second involve saving as premium on Google Earth directly. This method is very fast, but the image has to be geo-referenced using ArcGIS. For the purpose of this work, ArcGIS 10.1 software was used for geo-referencing. The attribute data obtained in this study includes the names of the existing schools, their location, the owners, total enrolment of the schools, and the number of facilities available in the school.

Creation of Database for secondary Schools: The digital map produced was exported into the ArcGIS10.1 software environment in order to create the required database. The individual attribute of each secondary school was created in using Microsoft Excel software and later moved to ArcGIS10.1 and Microsoft Access2007. A table was generated for each of the schools using ArcGIS 10.1 software and simultaneously, it related the rows/records to its similar theme, arc, or polygon depending on the features contained in each of them.

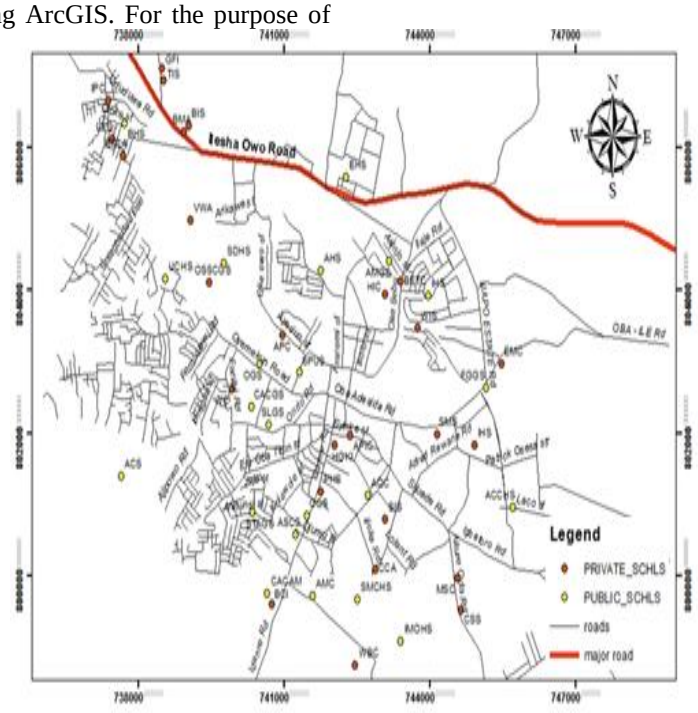

Fig 3: Location of secondary schools overlaid on the road network map of the study area

Query: The spatial database generated was queried both by location and by attribute. The query builder in Arc view software was used in building several queries to test its genuineness.

Some of the queries that were carried out in the study include:

1) Coordinates of secondary schools with their year of establishment.
2) Secondary school ownership and system type.
3) Secondary school students, academic and administrative activities, gender and total population.
4) Facilities present in each school.

RESULT AND DISCUSSION

Figure 3 and 4 shows the location of both public and private secondary schools overlaid on the road network map of the study area. Table 1 shows the coordinates of secondary schools with their year of establishment.

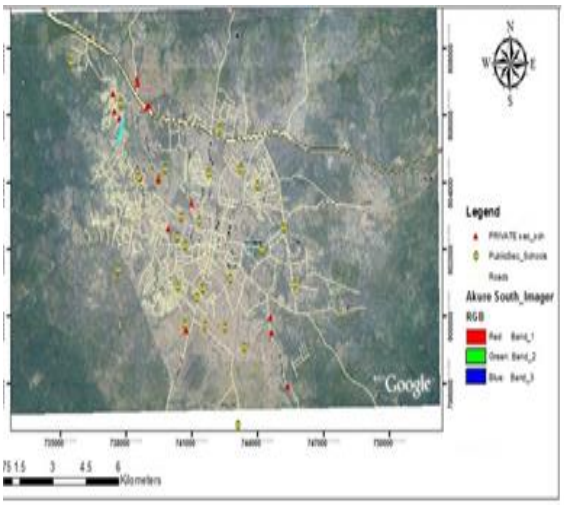

Fig 4: Digitized map showing the location of secondary schools in ArcGIS software environment.

Table 2 shows the number of public (Government) and private secondary schools within Akure South Local Government area. From the table, the number of secondary schools owned by the government and private individuals is 26 and 30 respectively; representing 45% and 54% respectively of the total secondary schools within the study area. This is also represented by a pie chart in figure 5.

From table 2, it can also be observed that the number of private schools are more than the government schools; thereby suggesting that private owned secondary schools are on the increase while the government owned secondary schools are either stagnant or are not established over the years within Akure South Local government. This further portrays that, the private sector are more involved in the education system, making it difficult for the less privileged to be educated.

Table 1: secondary schools with their coordinates

N	E	NAME
743176	804409	Adegbola Mem Gram Schoke Ijebu
745725	800957	African Church
741770	804287	Akure High Sch
741594	799725	Akure Muslim College, Akure
741240	800577	Akure Secondary Commercial School Akure
743105	796763	Alakunre Comp High Sch Ijoka
742742	801133	Aquinas College
737649	801392	Army Compr
737730	806346	Baptist High Sch
740329	802375	C.A.C Grammar Sch
740662	799760	Cac Adu Mem , Idanre
739466	804113	Celestial Gram Sch
742275	805583	Estate High Sch, Shagari Village
745170	802634	Fiwasaye
735479	807565	Futa Sec
743983	803929	Ijapo High Sch, Ijapo Estate
743407	799079	Ijo Mimo
747229	792945	Ogbe High Sch, Oda
741470	800840	Omoluorogbo Gram School
740505	802967	Oyemekun
739770	804381	St Dominic, Ilesha Garage
740688	802123	St Louis
742517	799664	St Micheal Catholic H/S Akure
741319	802850	St Peters
740357	800899	St. Thomas Ang. Gramm. School Akure
738552	804161	United Cac
738941	806230	Brilliant Model Academy Roadblock
739041	806305	Basic Intl Sch, Orita Bele
738520	806945	Trinity Intl Sch
738500	807110	God's Favour Intl College
739928	802615	Winners Cllege
742208	801826	His Grace Intl
737684	805895	Bola Intl
737467	806116	Lifspring College
737391	806652	Idris Premier
739466	804113	Olufunmilayo
740982	803379	Accurate Premier Cllege
745373	797924	Christ The Redeemers Oda Road
744646	799517	Calvary Sec Sch Oda
744584	799965	Magen And Shield College Oda
740748	799597	Bolsamm College Idanre
739074	804975	Van Winkle Academy
742884	800084	City College Akure
738123	807488	Salas Universal
743405	804133	Bethany College
741759	801182	Prospect High School
743088	803950	Holyfield Int College
742469	798740	Willy Bright College
742366	801971	Accurate Pioneer College
743089	800787	Sam Int. Sch
743763	803473	Watersprings Int. Sch
745728	796678	Calvary Int.
744935	801824	Impact High Sch
745476	802978	Emplace College
737488	808238	Apex De Unique
744160	801988	St Mathias

Table 2: Public and private secondary schools

School Type	Number	Percentage
Public (Government) School	26	46%
Private School	30	54%
Total	56	100%

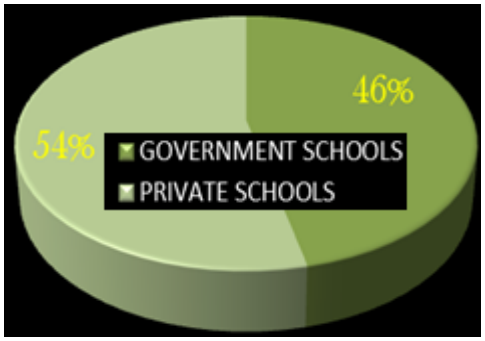

Fig 5: pie chart showing the percentage of government and private secondary schools

Secondary schools and facilities: Query was also performed to identify the number of secondary schools having science laboratories, library, sporting centres and computer facilities. Table 3 shows the secondary schools with their available facilities.

Table 4 is a summary of the total number of science laboratories presents in government secondary schools within the study area. As can be seen from the table, 12 schools have the three (3) laboratories, representing 46%. It can also be observed that there are 11 schools that use one (1) laboratory for the three practical works, which represent 42% and 3 schools have no laboratory representing 12% as shown in figure 6.

Table 3: facilities in secondary schools

SCHO_NAME	PHY LAB	CHEM LAB	BIO LAB	SICK BAY	LIB	SPORT	COMPTR L
ADEGBOLA MEM GRAM SCHOOL IJEBU	0	1	0	0	1	FIELD	1
AFRICAN CHURCH	0	1	0	0	1	FIELD	1
AKURE HIGH SCH	1	1	1	0	1	FIELD	0
AKURE MUSLIM COLLEGE, AKURE	1	1	1	0	1	FIELD	1
AKURE SECONDARY COMMERCIAL SCHOOL AKURE	1	1	1	0	1	FIELD	1
ALAKUNRE COMP HIGH SCH IJOKA	0	1	0	0	1	FIELD	1
AQUINAS COLLEGE	1	1	1	1	1	FIELD	1
ARMY COMPR	1	1	1	1	1	FIELD	1
BAPTIST	0	0	0	0	0	FIELD	0
C.A.C GRAMMAR SCH	1		0	1	1	FIELD	1
CACADU MEM , IDANRE	0	1	0	0	1	FIELD	1
CELESTIAL GRAM SCH	0	1	0	0	1	field	1
Estate high sch, shagari village	0	1	0	0	1	FIELD	1
FIWASAYE	1	1	1	1	1	FIELD	1
FUTA SEC	1	1	1	0	1	FIELD	1
IJAPO HIGH SCH, IJAPO ESTATE	0	1	0	0	1	FIELD	1
IJO MIMO	0	0	1	0	1	FIELD	1
OGBE HIGH SCH, ODA	0	1	0	0	1	FIELD	1
OMOLUOROGBO GRAM SCHOOL	1	1	1	0	1	FIELD	1
OYEMEKUN	1	1	1	1	1	FIELD	1
ST DOMINIC, ILESHA GARAGE	0	1	0	0	1	FIELD	1
ST LOUIS	1	1	1	1	1	FIELD + COURT	1
ST MICHEAL CATHOLIC H/S AKURE	0	0	0	0	1	FIELD	1
ST PETERS UNITY SCH	1	1	1	1	1	FIELD	1
ST. THOMAS ANG. GRAMM. SCHOOL AKURE	1	1	1	0	1	FIELD	0
UNITED CAC	0	0	0	0	1	FIELD	1

Table 4: showing the number of laboratories

Schools	Number	percentage
Schools with one lab	11	42%
Schools with two lab	0	0%
Schools with three lab	12	46%
School with no lab	3	12%

Population of Secondary schools: Table 5 shows the total number of students in government schools in Akure south local government area and a corresponding chart showing the name of secondary schools with their population as presented in figure 7.

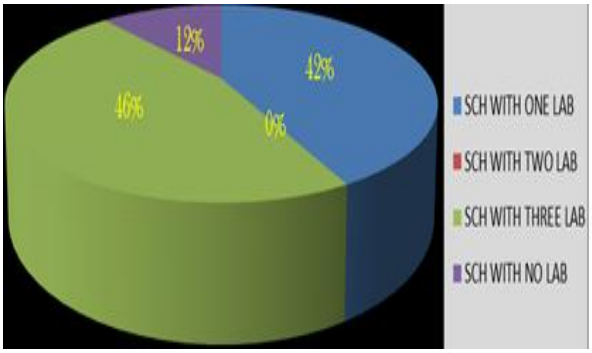

Fig 6: pie chart showing the percentage amount of schools with laboratories

Table 5: Population of students in government schools

S/N	Name Of Schools	Population
1	Futa Sec	3210
2	Celestial Gram Sch	3206
3	United Cac	3195
4	Oyemekun	2700
5	Baptist	2499
6	C.A.C Grammar Sch	2448
7	St Louis	2242
8	St Peters Unity Sch	2013
9	Akure High Sch	1940
10	Aquinas College	1861
11	Omoluorogbo Gram School	1822
12	Akure Secondary Commercial School Akure	1361
13	St. Thomas Ang. Gramm. School Akure	1350
14	St Micheal Catholic H/S Akure	1295
15	Ijo Mimo	1280
16	Akure Muslim College, Akure	1179
17	African Church	1148
18	Fiwasaye	1105
20	Army Compr	1082
21	Estate High Sch, Shagari Village	1000
22	Adegbola Mem Gram Schoke Ijebu	910
23	Cac Adu Mem , Idanre	820
24	St Dominic, Ilesha Garage	710
25	Ogbe High Sch, Oda	502
26	Ijapo High Sch, Ijapo Estate	470
27	Alakunre Comp High Sch Ijoka	415

From Table 5, it can be observed that FUTA secondary school with a total of 3210 students topped the list with the highest number of students, while Alakunle Comprehensive High school with 415 students was least populated within the study area.

Conclusion: The study integrated GPS and GIS in mapping of post-primary schools within the study area. The GPS was used in acquiring the coordinate of school locations and deploying into a GIS environment as a planning tool for analysis and map production. A database was created for each of the school taking into cognizes the major attribute. The created database reveals that some schools have complete facilities while others have incomplete facilities. Furthermore the study reveals that there are more private schools than government owned secondary schools.

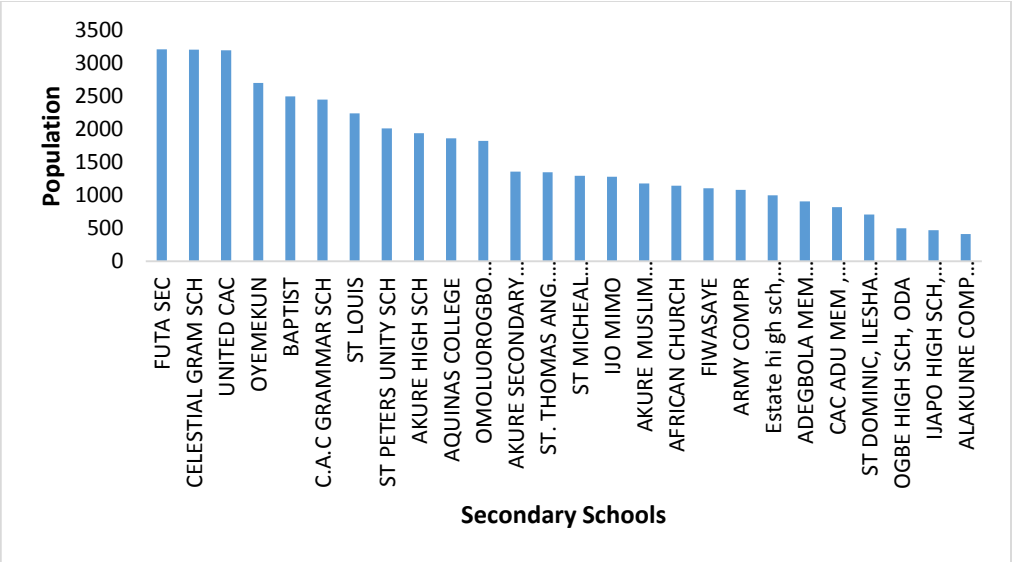

Fig 7: Stacked bar chart showing the schools with their population

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