

The Effect of Object Oriented Programming on the Implementation of Biometric Security System for Electronic Banking Transactions

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Abstract: *Right access to records is a sensitive issue especially in this era of electronic banking transactions. This paper focused on the feature of Object Oriented Programming and how it can be annexed to design a biometrics security system for securing electronic banking transactions. The Paper discussed the effect of object oriented programming concepts in designing Biometric security system for e-banking transactions. A survey was carried out with 100 respondents from the fields of IT, Banking and bank customers in Cross River State-Nigeria and data collected were analyzed using the arithmetic mean and presented in a 5-points likert-type scale. It was deduced from the analysis that biometric system though complex can easily be implemented with OOP languages. The research also revealed that not all mobile and hand-held devices have the features to support the use of biometric security system for electronic banking transactions. The research summarily revealed that OOP has the suitable features and ability to handle the complexities of biometric systems and can resolve the intricacies of integrating such biometric systems into electronic banking transactions to ensure authentic right of access to all banking transactions.*

Keywords: Object Oriented Languages, Electronic Banking, Online Transaction, Biometric Authentication, Bio-data

1. Introduction

One of the greatest achievements of the fifth generation computers was its ability to communicate and share data, applications, information, resources and devices. This potential was annexed into the development of software such as the search engines, and communication platforms using communication protocols. Based on the above, was the wide spread of computer and computer technology on the gathering, processing, storing, presenting and the communication of data/information from the source to the receiver [1]

Electronic transaction is the product of device communication which is concerned with the gathering, processing, storing and communication of data/information electronically [2]. Electronic transactions are the current trend of the 21st century in data communication and have found its application in almost all of human endeavour, especially in industries, government and organizations. Electronic transaction in the banking industries has given the entire banking industries a new life with high productivity, but has introduced a new security threat to the banking industries. This challenge therefore requires a securer security system for the banking industries. One of the sure security systems that can be integrated with electronic transactions to guarantee security is the biometric system. Biometric system is a system that integrates bio-data from individuals which is used in verifying and authenticating user's access to electronic transactions. Right from time being, biometric security has been guaranteed as a securer measure to protect and guard against unauthorized access to electronic transactions. The problem with Biometric system is its volume and space occupied in electronic transaction

which slows down drastically transactions speed. As such, its application on dynamic applications with growing database was not encouraged. With OOP which allows for data and code to be merged to form object with the features of cooperation and competition, it is the view of the researchers that object oriented programming will be able to enable for the creation of dynamic biometric system that will interact with banking transactions and enhanced a more effective security to the banking industries in Nigeria.

2. Research Objectives

The overall objective of this research work is to investigate how object oriented programming can be used to effectively implement biometric system in securing electronic banking transactions in Nigeria. The specific objectives include;

- (1) To review the concept of object and its role in programming interactivity in the banking sector
- (2) To investigate a more convenient way in which Biometric system can be applied in electronic banking transaction with less time slack using object oriented programming
- (3) To investigate if the Nigeria Banking System has what it takes to implement Biometric security in electronic Banking

3. Literature Review

Object Oriented Programming Concept: Object oriented programming is a programming paradigm based on object, class and data abstraction [2]. Object oriented programming other than procedural programming language which separates data from code, Object oriented programming languages merge both data and code as a single entity called object.

The collection of related objects is called class in object oriented programming. A class is the superset of objects with attributes which can be inherited by object members of the class. This makes programming more of a real life simulation with lesser codes, less time used, but with great output.

According to [3], Object oriented programming is defined as an act of programming which involves the reuse of entity in modeling new and real shape of realistic nature with identity that enable programming specifications, state, and behaviour within objects of different classes. [4] defines Object Oriented Programming as, a programming paradigm base on the concept of objects, which are data structures that contain

data in the form of fields, often known as attributes; and code in the form of procedures often known as methods. Object oriented programming is designed basically on the principles of data abstraction, inheritance, polymorphism and encapsulation. This allows for code reusability, blending of inherited attributes from other objects or parent class and security of program from the end user.

Programming languages used in executing object oriented programming are called Object Oriented Languages (OOL). There are over two (2) dozens of object oriented languages, but three major OOL are small talk, C++ and java. The table below summarizes the object oriented languages mentioned.

Table1: Brief features of three Object Oriented Languages

S/N	OOL	Year	Feature
1.	Smalltalk	1970s	Fully support OOP, Rich libraries, flexible, support run-time binding
2.	C++	Early 1980s	Support both procedural and object oriented programming compromise flexibility for fast execution, supports compile-Time binding
3.	Java	Early 1990s	Combine the features of small talk, C++ and Object Pascal to become robust, integrated in web and net application, portable.

Principle of Object Oriented Programming: Object oriented programming is integrated with features that allow for efficient interaction among objects to guarantee efficiency and suit for real time applications. The features of Object oriented programming include:

Object: Object is the integration of data and procedures with interface (method) through which it can be communicated to act accordingly. The flexible feature of object is characterized by three features viz; *State* (The representation of object at the coordinate, say x,y coordinate, e.g. (x,y) coordinates). *Behaviour* (change of state of object, e.g. dfy/dx coordinate) and *Identity* (the object field)

Class: A class is a collection of objects with the same characteristics which share common properties. Objects in a class interact with a given set of definitions. According to Onu et al (2015), a class has three kinds of members which include: *Field* that specify the kind of data that the objects hold; *Methods* that specify the operations that the objects can perform and *Constructors* that specify how the objects are to be created.

Modularity: Object oriented programming creates a modular structure that provides interface that allows for other units of code to be written and access without copying of code or writing explicit to discover its implementation details. Object oriented programming modularity enables modules to run flexibly in separate machine of different entities.

Reusability: this is one of the major features object oriented programming which creates room for the use of existing code to implement functions and procedures. This addresses problem of duplication of data or codes associated with the procedural programming language and pave way for flexible approach to software development.

Data Abstraction: Data abstraction is concerned with the definition of Abstract Data Type (ADT). This is concern with the critical analysis of a real life event with the possibility of translating same to machine executable.

Encapsulation: it is all about the mechanism by which data/objects and hidden from the end user.

Inheritance: it is the transfer or passing of the attributes of super class to subclasses or objects, eliminating repeated creation of such attributes in the subclasses and objects. This feature helps in the design of programs with little codes but with greater output.

Polymorphism: this is concern with the blending of inherited attributes from parent classes such that the inherited attributes fit the child class. Polymorphism tries to ensure that the inherited attributes of a subclass does not change the behaviour or content of the class, rather blends uniquely.

The Need for Object Oriented Programming in the Implementation of Biometric System

Object oriented programming with its paradigm of object creation, with the possibilities of objects inheriting the attributes of the parent class, sharing of common features of objects in a class, and the cooperative and competitive features of objects had led to the reusability of codes thereby cutting down reasonably the size of software. The interactive nature of object had also made it fit in real time application. Encapsulation feature of object oriented programming had made OOP fit well in developing systems with high level of security anticipated. A Biometric system is a system with a very large growing database containing bio-data of individuals. It is a more secure form of security system for electronic transactions, but its integration might lead to time lag in operations. For that reason, it does not fit properly into real time applications [5]. Due to the challenges faced by electronic transactions these days, it has come to the time

when the full integration of biometric system to secure such transaction is inevitable. It is the view of the researchers that Object Oriented Programming could help in the integration of Biometric system in electronic transaction security.

To achieve this integration, the paper has presented a design such that the individuals' bio-data and records are kept as two separate objects. A class of Bio-data should contain all the individuals' bio-data objects about an entity. In like manner, a class of record should contain all the individuals' record objects. Each individual's record object is dynamically linked to the bio-data object such that at any point a customer logged in, the customer's records and bio-data are filtered without time delay.

The ETSBS system is made up of n.....actors. one of the major actors (the customer) is shown in figure 2. This major actor have attributes of class: record and class: bio-data.

- 1) The major actors are expected to login to the system/webpage and be authenticated by the system.
- 2) The system automatically loads the actor's record from the *record* class and an embedded bio-data of the customer from the *Bio-data* class awaiting the next line of action by the actor.
- 3) On request for any transaction, the actor's bio-data is collected and matched with the stored bio-data as filtered from the biometric database (authentication).
- 4) If found authentic, access is then granted, otherwise access denied as logically shown in figure 3.

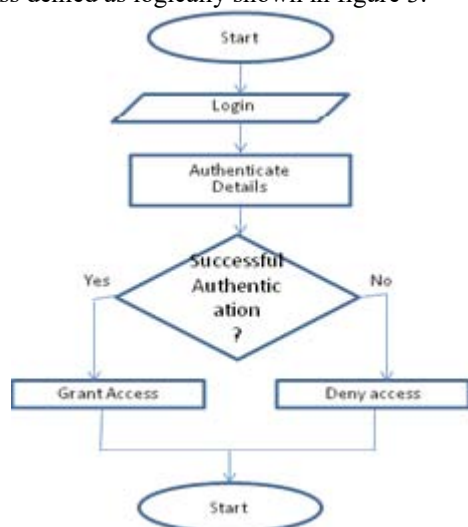


Figure 1: Logical design of ETSBS

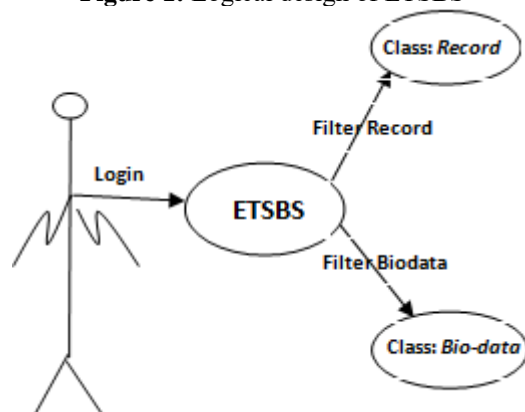


Figure 2: Single actor use case diagram of ETSBS

Development of Real Time Electronic System Using Biometric Security: By building standard working modules that communicates with each other instead of having to start writing the code from the scratch makes the system development a lot easier, cheaper and faster.

OOP helps to build the desirable future of portable and robust system through the help of inheritance and code reusability.

Building a secure ETSBS: Using the principles of encapsulation and polymorphism in OOPs brings to the application developer the following.

- 1) The possibility of creating multiple instances of object that co-exist without interference
- 2) The possibility of mapping object in the record class and bio-data class for efficient interaction.
- 3) The possibility of breaking the ETSBS based on objects
- 4) The data-centered design approach enables to capture more detail of the model of ETSBS
- 5) Object oriented programming fits easy upgrading and suits to use in implementing ETSBS using biometric features.
- 6) Object oriented programming makes interference descriptions with external systems simpler due to its message passing techniques for communication between objects.
- 7) Object oriented programming can manage software complexity very well [3].

Biometric System

The word biometrics which means "life measures" according to the Greek "bio" (life), and "metrics" (measures) is the measure of patterns of parts of the human body. Features measured include the finger prints, images (facial), iris, etc [6]. Biometric system is an application that makes use of biometric features to verify the authenticity of any electronic transaction. This system is more reliable than the use of passwords. It requires that the person being authenticated in the transaction to be present. Biometric systems are used for identification, access control and surveillance [5]. Biometric system provides more security to electronic banking transaction than the password and other text based systems.

Electronic Banking

Electronic banking is simply the application of computer and information technologies (information and communication technology (ICT)) into banking transactions such that banking transactions are not limited to the physical environment of the bank. Electronic banking allows banking transactions among the banks' global and local customers to be carried out electronically using computer resources. This removes completely geographical separation between a bank and her customers. So the the customer is not limited to the physical environment of the bank. Electronic banking services include; cash withdrawal and deposits, bill payments, fund transfer, account inquiries, payment for goods and services, airtime purchase, etc [7].

Devices used for electronic banking include mobile devices (GSM handsets, tablets, POS, notes etc), PCs and dedicated

machines like Automated Teller machine (ATM). Apart from the ATM that is designed specifically for electronic banking, for other systems and devices such as PCs and the mobile devices to function in electronic banking, the customer has to download and install electronic banking applications. Banks have developed various electronic banking applications like *firstmoney*, *easymoney*, *umobile* etc, depending on the bank. To use any of these apps, the customer will create online user account with a registered device from which he or she is given access code. Depending on the service subscribed to by the customer, some may require hardware or software token access. The kind of subscription determines the volume of money and transactions permitted for the customer in a day.

According to [7], ATM application in Nigeria electronic banking is the fastest growing ATM market in Africa rising from 83% in 2006 to 89% in 2007 with over 900 ATMs deployed and over 26 million ATM cards issued by 16 commercial banks and 14 micro finance banks. The ATM makes use of flat rectangular microchip card integrated with customer's access to banking services within his scope. The ATM cards are issued by the banking industries to their customers and are subject to expiration and renewal. The ATM cards are issued by three global payment card players, which are; master card, visa and inter switch.

4. Methodology

We used a survey design to enable us ascertain the opinions of respondents on the effects OOP has on the implementation of biometric security system in electronic banking transaction in Nigeria. We collected data from two main sources as discussed below.

Primary data source (Questionnaire)

Data was gathered from 15 academic staff, 5 software developers, 30 bankers and 50 bank customers with the use of structured and validated questionnaire. These respondents were selected from federal college of Education, Obudu, University of Calabar, Calabar, Cross River State University of Technology, Calabar; First bank PLC, Obudu, Ecobank Plc Obudu, and Zenith bank, Ogoja. The questionnaire sought the views of the respondents in their different groups on the effect OOP on the implementation of biometric system security in electronic banking transaction in Nigeria.

The questionnaire was divided into four sections. Each section was directed at a set of respondents thus:

- Section one collects data about the respondents;
- Section two collect data from computer professionals on the suitability of OOP in the design and implementation of Biometric security system for electronic transactions from bankers and banking staff;
- Sections three and four collect data on the assurance that biometric security system is a securer security system for electronic banking transactions, and the possibility that the banking industries has what it takes to implement Biometric security electronic banking respectively.

Secondary source: Documents and scholarly articles from computer science and other journals, text books, magazines, laboratory manuals and manuscripts, etc related to the subject of discussion were consulted. The major source of secondary data was the internet were most of the documents listed above were sourced.

5. Result presentation and summary of findings

A total of 100 respondents' opinion were sampled and responses collected and analyzed on a 5 point Likert-type scale as shown below. Table 2 shows the occupational distribution of the respondents and figure 3 illustrates the distribution in a pie chart.

Table 2: Occupation distribution of respondents

S/N	Respondents' occupation	No	Percentage
1.	Software developers	5	5%
2	lecturers	15	15%
3	Bankers	30	30%
4	Bank Customers	50	50%
	Total	100	100%

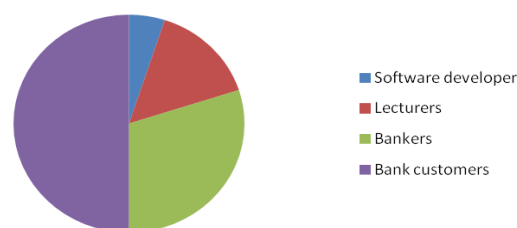


Figure 3: Pie Chart showing the occupation distribution of respondents

Table 3: Response from computer experts on the suitability of OOP in the design and implementation of biometric security system for electronic transactions

S/N	Question	X	F	FX	\bar{X}	%
1.	OOP enables programming in modules?					
	Strongly Agreed (SA)	5	15	75	5.00	100.00
	Agreed (A)	4	0	0		0.00
	Undecided (U)	3	0	0		0.00
	Disagree (D)	2	0	0		0.00
	Strongly Disagree (SD)	1	0	0		0.00
2.	OOP allows objects to cooperate and compete for data?					
	Strongly Agreed (SA)	5	11	55	4.67	73.33
	Agreed (A)	4	3	12		20.00
	Undecided (U)	3	1	3		6.67
	Disagree (D)	2	0	0		0.00
	Strongly Disagree (SD)	1	0	0		0.00
3.	OOP encapsulation feature can generate adequate security for its applications?					
	Strongly Agreed (SA)	5	9	45	4.47	60.00
	Agreed (A)	4	4	16		26.67
	Undecided (U)	3	2	6		13.33
	Disagree (D)	2	0	0		0.00
	Strongly Disagree (SD)	1	0	0		0.00
4.	OOP presents interactive interface for smooth and timely interactions with its application?					
	Strongly Agreed (SA)	5	10	50	4.67	66.67
	Agreed (A)	4	5	20		33.33
	Undecided (U)	3	0	0		0.00
	Disagree (D)	2	0	0		0.00
	Strongly Disagree (SD)	1	0	0		0.00
5.	Management/expansion of OOP application is cheap, smooth and fast?					
	Strongly Agreed (SA)	5	5	25	4.13	33.33
	Agreed (A)	4	8	32		53.33
	Undecided (U)	3	1	3		6.67
	Disagree (D)	2	1	2		6.67
	Strongly Disagree (SD)	1	0	0		0.00

Table 4: Response from the entire respondents on the application of biometric security system for securing electronic banking, and its implication in the banking industries

S/N	Question	X	F	FX	\bar{X}	%
1.	Biometric security is securer to code security in electronic transaction?					
	Strongly Agreed (SA)	5	61	305	4.41	61.00
	Agreed (A)	4	25	100		25.00
	Undecided (U)	3	11	33		11.00
	Disagree (D)	2	2	2		2.00
	Strongly Disagree (SD)	1	1	1		1.00
2.	Biometric security requires authentication and verification?					
	Strongly Agreed (SA)	5	15	75	3.42	15.00
	Agreed (A)	4	48	192		48.00
	Undecided (U)	3	12	36		12.00
	Disagree (D)	2	14	28		14.00
	Strongly Disagree (SD)	1	11	11		11.00
3.	Biometric security has natural features and does not permit impersonation?					
	Strongly Agreed (SA)	5	12	60	3.27	62.00
	Agreed (A)	4	48	192		48.00
	Undecided (U)	3	18	54		18.00
	Disagree (D)	2	10	20		18.00
	Strongly Disagree (SD)	1	1	1		1.00
4.	All electronic banking devices has biometric capturing features?					
	Strongly Agreed (SA)	5	2	10	1.89	2.00
	Agreed (A)	4	12	24		12.00
	Undecided (U)	3	19	57		19.00
	Disagree (D)	2	31	62		31.00
	Strongly Disagree (SD)	1	36	36		36.00
5.	Biometric data are heavy and requires high storage capacity devices?					
	Strongly Agreed (SA)	5	23	115	3.24	23.00
	Agreed (A)	4	31	124		31.00
	Undecided (U)	3	4	12		4.00
	Disagree (D)	2	31	62		31.00
	Strongly Disagree (SD)	1	11	11		11.00
6.	Nigeria banking industries make use of cloud storage in their operations?					
	Strongly Agreed (SA)	5	24	120	3.32	24.00
	Agreed (A)	4	10	40		10.00
	Undecided (U)	3	40	120		40.00
	Disagree (D)	2	26	52		26.00
	Strongly Disagree (SD)	1	0	0		0.00

6. Discussion

In table 3, the survey analysis showed that the arithmetic mean for the factors presented to test the suitability and fitness of OOP in the implementation of biometric system for electronic banking was high. The mean ranges was from 4.13 to 5.00 with average mean value of 4.59. That was a strong indication that OOP is suitable for the implementation of biometric systems for online transactions. That was true since electronic banking systems needed modularity, security, interactivity and competition for data constantly. OOP tools have these features, and therefore becomes the required software techniques for the design of biometric security system for securing electronic banking transactions.

The paper presented in table 4 the response from the entire sampled population to the questions bothering on the application of biometric security system for securing electronic banking, and its implication in the banking industries. The researcher had it in mind to investigate if actually, biometric system can be a better security system and whether it can be integrated in electronic banking. It was discovered that, one of the variables that seeks to know if all electronic appliances used in electronic banking had biometric features for effective integration of biometric security system used for securing electronic banking, had a mean response of 1.89 which was very low. That implies

that if biometric system is integrated in electronic banking, many devices used for electronic banking will be rendered obsolete. Though that would be a challenge per say, it is the expectation of the researcher that it is a positive challenge with the hope that, it will rather trigger further research in technology to come up with electronic data communication devices with biometric features inclusive.

Other factors analyzed have arithmetic mean range from 3.24 to 4.41 which were in affirmative. Biometric security is better than code/text based security, it requires authentication and verification before access is granted, and the use of bio-data meaning that the right person is verified and authenticated before granting access to the electronic banking transaction at any point in time. These features proved that biometric security system is better for electronic banking. And to achieve these desirable features, OOP tools are the most suitable.

Also, in the applicability of biometric security in electronic banking, it was discovered that bio-data are heavy and as such needs high speed processing and large storage capacity for it to work effectively. This is no longer a problem since from table 1 above, it was uncovered that OOP can be used to modularize the biometric security system, and create cooperative and competitive interaction among the modules. That reduced the complexity to manageable systems. For large data density, the offline and cloud storage are readily available options for large and growing database. As such,

banks that have not subscribed to cloud computing may need to do so for effective implementation of biometric system for securing electronic banking.

7. Conclusion

It is obvious that biometric security system deals with large and heavy database of bio-data of banking customer, staff and regulators. It is also true that based on the complexity and high memory usage of biometric systems, it has over time been difficult in its full integration in electronic and real time application. Considering the high level of crime and impersonation in the banking industries and its adverse effect on the economic, it has become necessary for the full integration of biometric security in the banking industries as a whole. The fear of complexity and large memory unit occupation by biometric system has been addressed in this paper with the use of OOP in its design and implementation, and the used of offline storage and cloud computing and storage to manage the database.

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