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Conceptual Framework for a Hybrid Identity Verification System for Business to Business Export Portal

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ABSTRACT

An identity verification service is used by businesses to ensure that users or customers provide information that is associated with the identity of a real person. It has developed from just physical security to generic security measures for both online and offline systems. In the case of Business to Business (B2B), the third party (such as Nigerian Export Promotion Council (NEPC)) managing the two parties needs a reliable scheme to verify the members of both parties. This plays a crucial role in membership classification, identification and sensitization. In this work, a hybrid system for identity verification for B2B export portal is developed using Nigerian Export Promotion Council (NEPC) as a case study. The system derives its hybridization from integrating some attributes of personal identity with those of business entity identity. A question of "how can peoples' identity be verified without the threat of identity theft" is answered by the thrust of the research as it seeks to create a hybrid system of identification, i.e. using various elements of identity to verify individual organization and owner from a pool of records in a database. In the work, a novel approach is proposed using a fuzzy logic technique to determine trust-factor of a business entity which serves as a major factor in recommendation of local product/service marketers to the customers abroad. The interface is developed using HTML and the back end with MySQL scripted with PHP.

Keywords: *Hybrid, Export, Verification, Export Portal, Security, Biometric*

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1. INTRODUCTION

In the context of information security, an identity verification service is used by businesses to ensure that users or customers provide information that is associated with the identity of a real person. It was first used as a mechanism to enforce physical security such as using badge, identity cards and tags etc. Nowadays, identity verification is one of the major mechanisms in user authentication. It is used in almost every system that requires authentication. Security policies must be based on the identity of users and the applications in use and not just on IP addresses, ports, and protocols. Without knowing and controlling exactly who (users) and what (applications and content) has access to the network and its various assets, networks may be compromised by threats that can easily bypass port-based network controls.

The need for adoption of strategies in verifying the identities of people in our world today cannot be over-emphasized. It is a standard practice to issue a disclaimer on a person(s) that is/are no longer associated with a particular organization to alert the public on the risk of subsequent transaction with the person; but; this information sometimes gets to the intended recipients when some fraudulent acts might have been committed. So we currently live in an era when everyone should be vigilant and conscious of the identity of everyone in his/her environment. Authorized individuals may be employees, technology service provider (TSP) employees, vendors, contractors, customers, or visitors. Access should be authorized and provided only to individuals whose identity is established, and their activities should be limited to the minimum required for business purposes.

Recurring security challenges and menace of false identity claims in our society calls for a holistic approach from stakeholders to overcome this ugly trend. Identity theft and fraudulent document production are reaching alarming levels all over the world. Human identification is a delicate notion which requires consideration at all levels of management. Incidences of fake identity abound in the country. It becomes complicated when the task of checkmating people's identity is left for the law enforcement agencies alone. Therefore, there is the need for the development of a basic verification tool that is readily accessible to people everywhere and anytime (Ogbuokiri, Agu, and Nwoye, 2015).

As we all know, international trade in general leverages on trust to grow and bloom. For the Nigerian international business person, the experiences have been different, a sour and sweet situation. The trust perception for Nigerians in the international community is low. This is due to several fraudulent activities of some Nigerians both home and abroad. The most prominent is the Advance-fee fraud cases tagged Nigerian scam which is greatly affecting the quality and volume of transactions with Nigerians. The number 419 is the Nigerian criminal code (Criminal Code Act, Laws of the Federation of Nigeria 1990) that deals with it.

This project is therefore addressing the trust issue using basic but standard regulatory provisions within the industry. It is expected that businesses registered with the intention to scam will be greatly filtered through the rules provided by the fuzzy logic embedded in the identification process. In that case, more genuine business with track records on meeting all regulatory provisions will be given high rating for business at the international arena.

In this work, a hybrid system for identity verification for business-to-business (B2B) export portal is designed to primarily promote Nigerian exportable products. Business-to-Business (B2B) is Electronic Commerce (EC) between two or more business partners via the third wave of EC where the interactions among a very wide range of organizations should be handled seamlessly and dynamically without problems in ad hoc integrations (Travica, Kajan, Josanov, Bubanja and Vuksanovic, 2006).

Export Portal is an online system which facilitates transactions between global businesses, companies, sellers, buyers, and shippers worldwide.

1.1 Statement of the Problem

For the Nigerian business entities, their access and interaction in international business scenario is challenging and different. Owing to no fault of theirs, they face an immense challenge of trust unlike their counterparts in other climes. In Nigeria, both genuine and fake business entities register and get permits to export. While the genuine businesses will thoroughly follow through all processes, the fake business will always want to cut corners in order to make more profit thereby exacerbating the long-standing trust issues that currently pervades the international business environment.

It is important to understand that buying and selling is no longer restricted to the conventional markets such as the Trade Fairs, Trade missions and contact Promotion (Isemede, 2014). The virtual market based on

the number of mobile penetration and other online users in the world is greatly metamorphosing from the conventional to the virtual market place.

However, it is important to apply caution when creating an online market place. The portal may further worsen the dwindling image of the country if proper verification processes are not in place to validate genuine businesses. These processes also rate the business based on available records providing different level of recommendations for business people in Nigeria.

It is obvious that verification of identities of Nigerian goods marketers and service providers is not negotiable as the growing of cyber insecurity, such as the threat of identity theft, is growing at alarming rate.

It is a standard practice to issue a disclaimer on a business entity that is no longer associated with Nigerian Export Promotion Council (NEPC) to alert the public on the risk of subsequent transaction with it; but this information sometimes gets to the intended recipients when some fraudulent acts might have been committed. In most cases NEPC fails in identifying the members due to weakness and unnecessarily complex verification processes. This later leads to inconsistence in data collection, inaccurate monitoring and evaluation of the progress of the industry.

1.2 Aim and Objectives of the Study

The aim and objectives of the study is to develop a hybrid identity verification system for B2B export portal using Nigerian Export Promotion Council (NEPC) as case study. In order to fully develop the above system, the following considerations are made:

i. Ascertaining the significance of identity verification in the context of information security
ii. Developing hybrid identity verification using integration of various identity verification techniques.
iii. Developing a system that allows NEPC to fully identify the entire Nigerian participants in the export industry and to place a level of trust on them. In other words, this is to ensure that no member can access and transact business on the platform without a guarantee of the status of their representatives.
iv. Among other questions, our work seeks to provide answer to a question of "how can people's identity be verified without the threat of identity theft" as it seeks to create a hybrid system of identification, i.e. using various element of identity to verify each organization and owner from a pool of records in a database.

1.3 Nigerian Export Promotion Council

The introduction of a business-to-business (B2B) export portal is therefore another platform that will primarily promote Nigerian exportable products (Nigerian Export Promotion Council, 2017; Madu, 2010) as captured in the mandate of NEPC(Nigerian Export Promotion Council, 2010).

The Council is constituted to play the role of a facilitator between Nigerian marketers of products/services and customers/clients abroad. In other words, the Council provides permits to export non-oil products. It also facilitates the export of these products through sourcing for markets for local products/services as well as making recommendations to foreign buyers. The categories of products include Agricultural products, solid mineral, petrochemical products, services and manufactured products. Based on the requirements of the system, security in terms of identity verification becomes a major concern.

2. LITERATURE REVIEW

2.1 IDENTITY AND INFORMATION SECURITY

Committee on national security systems (CNSS), an American intergovernmental organization that sets policy for the United States security system defines information security as the protection of information and its critical elements, including the systems and hardware that use, store, and transmit that information (Whitman and Mattord, 2012).

On the other hand, information can be defined as data endowed with value and purpose (Davis et al., 2017). It plays a very critical role in every life. Information has become an indispensable component of conducting business for virtually all organizations. In a growing number of companies today, information is the business. Therefore, it is not only necessary to secure information but also imperative to protect it from any agent of corruption, both intentionally and unintentionally, and making it available for use to the authorized user.

Also, (Anderson, 2003) defined information security as a "well-informed sense of assurance that the information risks and controls are in balance." This definition lays more emphasis on check and balance between information risk and control. In other words, the level of risk on information should determine the level of

security control placed on the said information. The CNSS on information security as defined here cut across securing information and its assets throughout its entire life cycle.

In general, security is the quality or state of being secure—to be free from danger. In other words, protection against adversaries—from those who would do harm, intentionally or otherwise. The value of information comes from the characteristics it possesses. When a characteristic of information changes, the value of that information either increases, or, more commonly, decreases. Some critical characteristics affect information's value to users more than others do. The critical characteristics of information are availability, confidentiality, integrity, authenticity, accuracy, utility and possession. The aim of every information security technology is to preserve one or more of the critical characteristics of information.

2.2 IDENTITY THEFT

For identity theft, most analogy in this project will come from the United States owing to the developed structures and framework on information security available to mitigate the trends. The Federal Trade Commission (FTC) of the United States of America describes identity theft as the use of someone else's personal identifying information, like your name, social security number, or credit card number, to commit fraud or other crimes without their permission (Federal Trade Commission, 2004). The FTC estimates that perhaps as many as nine million Americans are faced with identity theft each year. Many people, among them perhaps you or someone you know have been affected by some form of identity theft.

2.3 AUTHENTICATION

Authentication is the process of validation of a supplicant's purported identity (Whitman and Mattord, 2012). There are three main authentication factors namely: Something a supplicant knows, something a supplicant has, and something a supplicant is

i. **SOMETHING A SUPPLICANT KNOWS:** this is what the supplicant knows and can recall—for example, a password, passphrase, or a personal identification number (pin). Passwords are private words or combinations of characters that should be known by only the users. A password should be difficult to guess, it should not be a series of numbers easily associated with the user, but the password must be something the user can easily remember. A passphrase is a series of characters, which is usually longer than a password. Passwords are usually derived from passphrases. A typical passphrase might be "maytheforcebewithyoualways," represented as "mtfbwya." for a password.
ii. **SOMETHING A SUPPLICANT HAS:** this is something a supplicant has and can produce when necessary. Examples are ID cards, ATM cards and tokens that contain a computer chip that can verify and validate a number of pieces of information which allows users to gain access to a system.
iii. **SOMETHING A SUPPLICANT IS OR CAN PRODUCE: -** this includes individual characteristics, such as hand topography, hand geometry, fingerprints, palm prints, or retina and iris scans. It also entails something a supplicant can produce on demand, such as voice patterns, signatures, or keyboard kinetic measurements. Some of these characteristics are referred to as biometrics.

2.4 ACCOUNTABILITY

Accountability is also known as auditability. It ensures that all actions on a system (whether authorized or unauthorized) can be attributed to an authenticated identity (Whitman and Mattord, 2012). Accountability is most often accomplished by means of system logs and database journals, and the auditing of these records.

2.5 BIOMETRIC ACCESS CONTROLS

This is the use of measurable human characteristics or traits to authenticate the identity of a supplicant (Whitman and Mattord, 2012). It relies upon recognition of those features one relies upon to identify friends, family, and other people they know.
Biometric authentication technologies use the following human features: Fingerprint, Palm print, Hand geometry, Facial geometry, Retinal print, Iris pattern.

Figure 1 depicts some of these human recognition features. Most of the technologies that scan human characteristics convert these images to minutiae. Minutiae are unique points of reference that are digitized, encrypted and stored when creating the user's system access credentials. Afterwards, during access attempts, these access credentials are compared with the encoded value to determine if the user is who he or she claims to be. But as some human characteristics can change over time, due to normal development, injury, or illness, this method faces challenges which means that system

designers must create fallback or failsafe authentication mechanisms.

2.6 BUSINESS-TO-BUSINESS (B2B) ARCHITECTURE AND SECURITY ISSUES

(Travica, Kajan, Josanov, Bubanja and Vuksanovic, 2006) defined B2B as electronic commerce (EC) between two or more business partners via the third wave of EC where the interactions among a very wide range of organizations should be handled seamlessly and dynamically without problems in ad hoc integrations. In other words, (Travica et al., 2006) described B2B as electronic commerce between two or more business partners via the third wave of EC as described below;

i. The first wave of EC consists of a company website that offers a catalogue of its products and services which can be discovered through web farming then systematically collecting relevant business data in order to integrate them into the existing data warehouse.
ii. The second wave of EC carries the customers who have already established some kind of on-line shopping with a limited number of their suppliers (like classical edi) using their websites and central database support.
iii. A surfer on the third wave of EC (B2B) requires the interactions among a vast variety of organizations to be handled seamlessly and dynamically with no problems in ad hoc integrations.

(Travica et al., 2006) also established that the total revenue all over the world from EC has been estimated to reach 5.578 billion USD, that this is an extremely good challenge for various attackers, small talented hackers, big criminals, competitive companies, etc.

Generally, B2B system may not necessarily involve online payment but must involve one or more commerce activities such as exchange of business information, marketing, canvassing linking and sourcing for buyers and sellers, goods and services showcasing etc. Effective and efficient exchange and cooperation of information and goods between enterprises is a crucial prerequisite to compete successfully in globalized supply networks. Such business-to-business (B2B) integration affecting various partners across the whole supply network is very complex and dynamic by nature and may include multiple levels of integration (like data, application, business process, etc.) at the same time (Auinger, Nedbal and Wöss, 2009).

(Kessel and Allan, 2015) made conclusions during the 18th annual survey on creating trust in the digital world, this report investigates the most important cybersecurity issues facing businesses today. About 1,755 organizations participated in the survey, and the report is based on insights extracted from the results and from the extensive global experience of working with clients on improving their cybersecurity solutions. It is concluded that "the constant bombardment of three to four years of numerous attacks and having to react to cyber events can easily provoke complacency. A strong record in repelling humdrum "typical attacks" (e.g., phishing) and plugging the obvious gaps (e.g., identity and access management functioning effectively) can lead organizations to think they have "solved" the problem of cybersecurity, when in reality the situation is getting worse. This is especially true as it can be very difficult to demonstrate the value of the investment in real terms when budgets are tight" (Kessel and Allan, 2015) also, "18% do not have an identity and access management program while in 2014, this figure was 12% - this represents a serious drop" (Kessel & Allan, 2015)

2.7 HYBRIDIZATION

Having reviewed the literature, we observed there are two categories of identification and verification; the one designed to identify personal identity (Li & Wang, 2015) and the other for organization identity (Kessel and Allan, 2015). For instance, while biometric is suitable personal identification it is not ideal for organization identification since an organization is an established entity not referring to a single person. Therefore, the ideal form of identification is multiple elements that can be used to uniquely identify the organization. Our work seeks to achieve exactly this. Our intention now is to develop a hybrid system of identification on NEPC B2B system for all Nigerian exporters to be uniquely identified.

The method attempts to derive its hybridization from integrating attributes of personal identity with those of business entity identity for verification.

2.8 FUZZIFICATION

Fuzzification is the application of Fuzzy Logic (FL) which is a method of reasoning that resembles human reasoning. In other words, it is Artificial Intelligence. Fuzzification involves the conversion of a crisp (precise) input value to a fuzzy (imprecise) value by the use of information in a knowledge base (Kayacan and

Khanesar, 2016). Artificial Intelligence systems can be used to enhance inter organizational trust and commitment in business settings (Watson, Weaven, Perkins, Sardana, and Palmatier, 2018).

3. METHODOLOGY

3.1 Research Design

The paper proposes a system that allows the Nigerian Export Promotion Council (NEPC) that manages B2B system identifies each business entity on the system and also be able to classify them into active, partially active and non-active.

In order to achieve our goal of this work, the first task here is to develop the architecture and framework on which the system is based using object-oriented analysis and design (OOAD) methodology. Then we will develop various algorithms for heuristic and fuzzy algorithms procedures. Finally, we implement our work, by transforming the algorithm into codes in php to demonstrate the technique of hybridization using multilevel approach as mentioned earlier with the aim of identifying the member.

3.2 Proposed System Model

The roles of NEPC in the B2B model includes sourcing for local export markets through registration and identification and recommending identified local exports companies to foreign buyers. It is very important to note here that the system does not cover payment and NEPC does not involve in transactions between the two parties. However, the recommendation of local companies to foreign ones is based on trust on the former which in turn depends on the identifications.

The entire system involves various stages as shown in figure 3. The first stage is the registration of a company by supplying of identity (a set of attributes). Each attribute of the identity is verified against the database content in case another company has the same attributes (duplicate). If duplicate attribute found, the registration would be rejected else accepted. The second stage is the retrieval of identity and determination of trust and activeness of the company based on some attributes as discussed in section 4.2. The last stage is the recommendation of company's products to foreign buyer(s) depending on the level of trust (high, moderate and low).

3.3 Identity Verification Algorithm

Consider that we have company identity attributes which are identifiers commonly used in record management systems managed by organization like NEPC to distinguish one Company from others.

3.4 Identity Trust Determinant through Fuzzy Logic

Having established the identity verification procedures, the next task is to define the trust of business entity. We use Fuzzy logic (multivalued logic) to model problems that deal with ambiguous data. It is a generalization of the traditional bivalent logic. Consider the statement,

"The trust NEPC has with Company A is very low"

The above statement is ambiguous, because where can the line for "very low" be drawn? Fuzzy logic holds that everything is a matter of degree; for example, the trust we develop with any Company might be 20% activeness to be set of low trust company and maybe 90% activeness to be set of high trust company.

The method to solve this challenge is similar to the one in (De Ru and Eloff, 1997) which is to consider the linguistic rules describing the control system consisting of two parts; an antecedent block (between the IF and THEN) and a consequent block (following THEN. By making this type of evaluation, usually done by an experienced operator, fewer rules can be evaluated, thus simplifying the processing logic and perhaps even improving the fuzzy logic system performance.

3.4.1 Fuzzy rules definition (Rules Base)

The rules base is assembled with the following structure: If <premises> Then <conclusion>. For the rules definition of the fuzzy system concerned, we could standardize the following structure as in (Cicília, Glaucia, Adrião, Ricardo, & Ana, 2011)

- R: $\{R_1, R_2, R_3,...,R_n\}$ → Set of rules;
- SV: $\{SV_1, SV_2, SV_3,..., SV_n,\}$ → Set of vital signs;
- D: $\{D_1, D_2, D_3,..., D_n\}$ → Set of possible output;

P: {n, l, h} → Parameterization of signals (normal, low and high

i. **System output**: - Because our methodology aims to categorize uniquely each company's identity level of trust based on trust factor, the output will be the categorization of this trust. This categorization, along with a level of activeness, will be the differentiating criterion for identifying the user.

ii. **System inputs**: - Our methodology uses two inputs to categorize a company's trust pattern. First, it uses company's change in tax paid i.e. the change in successive tax paid. We believe the tax is evaluated on pay as you earn basis which is paid at the end of each business dealing. Also, because of its feasibility, we decide to use tax instead of capital base. It therefore means that a company with increment in tax indicate it is functioning. The second system input for this project is the duration of operation. It is believed that a company can only stay long in business if it is doing well. It is therefore inferred that a company either goes bankrupt and fold up or make profit and continue to be in business.

Definitions:
INPUT#1: ("Change-in-tax = tax2-tax1")
Change-in-tax: Low, Medium, High
INPUT#2: ("Operation- Duration")
Operation-Duration (*Op-Duration)*: Low, Medium, High
CONCLUSION: ("Output: Trust-Factor: Low, Medium, High")

3.4.2 Fuzzy Logic Control

Then linguistic rules for the work are given below;

Rule1. If Op-Duration is Low Then Trust-Factor is Low
Rule2. If Op-Duration is Medium Then Trust-Factor is Low
Rule3. If Op-Duration is High Then Trust-Factor is Low

Algorithm 3.3: Rule set for Operation duration, fuzzy logic control

Rule1. If Change-In-Tax is Low Then Trust-Factor is Low
Rule2. If Change-In-Tax is Medium Then Trust-Factor is Medium
Rule3. If Change-In-Tax is High Then Trust-Factor is High

Algorithm 3.4: Rule set for Change-in-Tax, fuzzy logic control

To be able to use the linguistic rules, we need to relate these precise values to linguistic sets. It is a graphical representation of the magnitude of participation of each input as shown in Figure 5 and 6. The rules use the input membership values as weighting factors to determine their influence on the fuzzy output sets of the final output conclusion. Figure 5 shows membership representation of years of operation. The authors chose values below 3years as the low (no profit) years, 3 to 9 years as the moderate years and above 9 years as the high years of operation.

In other words, the level trust increases with years of operation with all things being equal. Also, in figure 6, the change in tax is represented in which the change can be positive or negative; the neutral is zero meaning no change of tax over time. Another point to note is the overlapping of the triangles which is the main essence of fuzzy logic.

As inputs are received by the system, the rule-base is evaluated. The antecedent (IF X AND Y) blocks test the inputs and produce conclusions. The consequent (THEN Z) blocks of some rules are satisfied while others are not. The conclusions are combined to form logical sums. These conclusions feed into the inference process where each response output member function's firing strength (0 to 1) is determined. The inputs are combined logically using the AND operator to produce output response values for all expected inputs.

Rule1: If Op-Duration is Low AND Change-In-Tax is Low Then Trust-Factor is Low
Rule2: If Op-Duration is Medium AND Change-In-Tax is Low Then Trust-Factor is Low
Rule3: If Op-Duration is High AND Change-In-Tax is Low Then Trust-Factor is Low
Rule4: If Op-Duration is Low AND Change-In-Tax is Medium Then Trust-Factor is Low
Rule5: If Op-Duration is Medium AND Change-In-Tax is Medium Then Trust-Factor is Medium
Rule6: If Op-Duration is High and Change-In-Tax is Medium Then Trust-Factor is High
Rule7: If Op-Duration is Low AND Change-In-Tax is High Then Trust-Factor is Medium

Rule8: If Op-Duration is Medium AND Change-In-Tax is High Then Trust-Factor is High
Rule9: If Op-Duration is High AND Change-In-Tax is High Then Trust-Factor is High

Algorithm 3.5: Inference rules for Fuzzy Logic control

The above Inference rules for Fuzzy logic control using operation duration and change of tax can further be represented as in Table 3.1.

3.4.3 The Defuzzification of Output

The defuzzification of the data into a crisp output is accomplished by combining the results of the inference process and then computing the "fuzzy centroid" of the area. The weighted strengths of each output member function are multiplied by their respective output membership function center points and summed. Finally, this area is divided by the sum of the weighted member function strengths and the result is taken as the crisp output. To accomplish defuzzification, we adopt the Root-Sum-Square (RSS) algorithm which combines the effects of all applicable rules, scales the functions at their respective magnitudes, and computes the "fuzzy" centroid of the composite area. This method is more complicated mathematically than other methods, but was selected for this example since it seemed to give the best weighted influence to all firing rules.

$$OUTPUT = ((low\_center * low\_strength + med + high\_center * high\_strength)) / (low\_strength + medium\_strength + high\_strength))$$

Algorithm 3.6: Root sum square algorithm for defuzzification

3.5 Data Collection and Implementation

The implementation of the algorithms and development of a prototype of the work require data which is collected from our case study, NEPC. This data which is shown in Table 4.3 consists of information on Nigerian business entities involved in export business. This data with additional key information will be stored in database on which verification will be made. In addition to that, many issues and assumption would be made such the adjustment of data to determine low, medium and high. The boundary for this must be agreed upon among other things.

It is important to develop the accuracy of the system using

$$Accuracy = \frac{Total\ number\ of\ successful\ transactions}{Total\ number\ of\ transactions}$$

Algorithm 3.7: Performance check of the model

Source:(Kumar, 2012)

4. IMPLEMENTATION

4.1 Implementation Overview

To implement our algorithm developed in Section 3.3, we consider representation of the parameters based on the identity theories from the social science literature, an individual's identity is considered to have two basic components, namely a personal identity and a social identity (Li & Wang, 2015). Being a business entity, the attributes of identity used in this work is a modified version of personal identity, which are listed below for Corporate Affairs Commission (CAC), Nigeria Inter-Bank Settlement System (NIBSS), Nigerian Export Promotion Council (NEPC), Federal Ministry of Finance (FMF), Driver License (DL), Federal Inland Revenue (FIR), Internet Service Provider (ISP), Telecommunication (Telecomm), etc:

Bank Verification Number (BVN)(Central Bank of Nigeria, 2014) – Is one of the new and major entrants in the verification and validation process. The Central Bank of Nigeria (CBN) has been in the forefront of the KYC campaign, especially as it concerns its application within the financial industry. Since 2013, stringent guidelines have been rolled out by CBN to ensure that customers are identified, and traceability is not in doubt as far as transactions are carried out.

We consider this very crucial because of its uniqueness and its ability to map many account identities owned by a single person. This has been implemented nationwide to eliminate a single person masquerading as many people. This is very important to our proposed system for tracing a business entity to a person.

- Corporate Registration Number (RC) – We consider this very handy not only because of its uniqueness but also because it is a number assigned by government constituted body in charge of company registration and identification.
- National Identity Number (NIN) – Is issued by the National Identity Management Commission and is unique for every citizen above sixteen years of age. It eventually will be mapped to all social and non-social benefits of the country.
- NEPC assigned Number – This number also is important for its uniqueness and for the fact that it is assigned by the NEPC.
- Company name – The uniqueness of this entity may be trivial. However, it is required that each company is identified by name that can be merged with other attributes to uniquely identify the business entity.
- Company head's name – It is essential to identify at least a human being with an organization. It makes the entire system real and tangible rather than inanimate and abstract.
- Company line – This include phone number. This is only useful for communication between NEPC and the local company.
- Product information – it may be a product or set of products with descriptions. Although, not expected to be unique but included in order to have more information about the company in case the system is to be extended to mapping of foreign buyers.
- Company email – This is only useful for communication between NEPC and the local company.
- Year Registered – This will be used, with other criteria, to determine the level of trust and activeness of the local company.
- Year of last due paid – This will be used, with other criteria, to determine the level of trust and activeness of the local company.
- Previous tax paid
- Current tax paid

4.2 System Development

The identity verification system is web-based, on client-server architecture developed using standard software methodology. The interface is developed using HTML and the back end with MySQL scripted with PHP. The methodology is to do the following; (i) register some business entities - organizations (ii) allows administrator (NEPC) to update the business entity records (iii) display business entity information with level of trust on the computed using the fuzzy algorithm developed in Section 3.3. The strategy is to make the system robust enough to dynamically change the level trust so as to make a reliable recommendation to other party of the B2B.

4.2.1 Tables and relationship

This segment of the thesis deals with the relationship between the different tables. The three major tables for this exercise are the Exporters Table, the Buyers table, Product table and the Table that evaluates the level of trust. Please see appendix B for details of forms that links these tables. Fig. 4 is the login form that grants access to registered members. The username is the e-mail, NEPC ID and password. The members are free to reset their password only when they have an NEPC ID that is verifiable and e-mail address that is already in the NEPC database. There is also the issue of one-time password for new registrations on the platform to confirm the phone number which is another means of verification and identification. This is used mainly during reset to ascertain the identity of the member requesting for it.

4.3 Result of Deployment

Table 4.3 represents parts of multiple tables reflecting some data from 3 companies, AIG Stars, AIG group and Mekus-Durham and the Sellers who have won the bid for the supply with names; Chin Chun, Rushy Holdings and Black Panther. It is important to state here that even though there are several means of payment (Nigerian Export Promotion Council, 2016b) (Isemede, 2014) in international transactions, the most credible mode of payment is the letter of credit (Closed).

The closed letter of credit ensures that the product is confirmed to be satisfactory before the Importer Bankers will release the fund to the Exporter Bank. From Table 4.3, the trust level was varied based on the underlying logic created by Fuzzification of the two-input data, which are the year of registration which depicts the length of time in business and the change in tax, which is captured from the Tax-Id provided. It is to ensure that serious business venture, should not only stay on for long, but grow. The growth rate is deduced from the growing income tax. For the three-test sample above, the trust level was either High, low or medium. This was generated by the system through the Fuzzification of the inputs.

The final check is the performance test. Using the Performance check of the model algorithm and the sample data available the following simple evaluation was carried out:

$$Accuracy = \frac{Total\ number\ of\ successful\ transactions}{Total\ number\ of\ transactions}$$

Algorithm 3.7: Performance check of the model

Using 3 companies and the parameters for High, Medium and Low, the 3 companies tested showed successful transactions with the newly implemented system.
From the above formula:
Total number of transactions = 3
Total number of successful transactions = 3
It therefore implies that:
Accuracy = 3/3=1. To get the value in percentage, whatever value is multiplied by 100
=100%

5. DISCUSSION

This project is a product of necessity owing to the unique Trust issues Nigeria is facing in international trade, which imposes as impediment to business dealings from the country. Nigeria is ranking very high (144) in corruption perception index 2018 report Transparency International (2018). An earlier report from a survey conducted by World Bank for over 2000 exporting businesses from Nigeria between 2014 -15 corroborated this report with a statistic reflecting about 12.5% confirming that corruption was one of the major challenges of exporting businesses. This is the third challenge only behind electricity (27.2%) and finance (30.2%) This serves as caution for other nations doing business with Nigeria and is affecting export business from Nigeria.

International trade in contemporary times is gradually migrating to online virtual spaces as e-Commerce and several other transactional portals. Nigeria is yet to develop a government supported e-Commerce portal on export. This project is pre-empting the development of one and has gone ahead to prepare sub-components of an e-commerce site or portal to rank the Trust level of businesses registered on that platform based on criteria like years of operation in business and their change in income.

The research further includes more unique Identities like Bank Verification Numbers (BVN), National Identity Number (NIN), exporter verification status and other unique and non-unique identities to strengthen the verification process, which will also is used to heighten the Trust level.

As a result of the sample test done, the software implemented in this research shows successful transactions, thereby proving that such metrics can help businesses in the long term.

It is also important to know that the metrics can be made more complex with the addition of variables as the need arises in future research.

6. CONCLUSION

In this paper, we proposed and developed a hybrid identity verification system for B2B export portal with special reference to Nigerian Export Promotion Council (NEPC). The work is novel considering the context of the case study. Our research work contributed in two ways. First, we proposed a fuzzy logic specified in Figure 5 for computing trust level of business firm. The fuzzy logic uses various predicates to derive the value for the trust level which is in turn very important when it comes to recommending business to business. Secondly, we proposed a matching algorithm in Figure 2 for verifying businesses, rather than individual, for proving the authenticity of businesses which is one of the requirements for B2B system design.

We therefore recommend the proposed system mainly for business entity identity verification as it targets organizations rather than individuals. Although, organization cannot be identified without at least a person, but we are of the opinion that organization attributes should make up the larger parts of the attributes set.

6.1 RECOMMENDATION

In view of the above remarks, we therefore recommend a system mainly for business entity identity verification. This should target organization rather than an individual. Although, organization cannot be identified without at least a person, but we are of the opinion that organization attributes should make up the larger parts of the attributes set.

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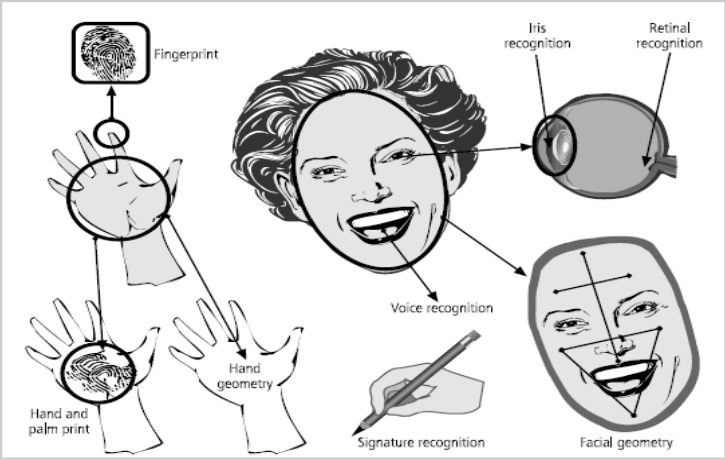


Figure 1: Biometric Recognition Characteristics
Source: (Whitman & Mattord, 2012)

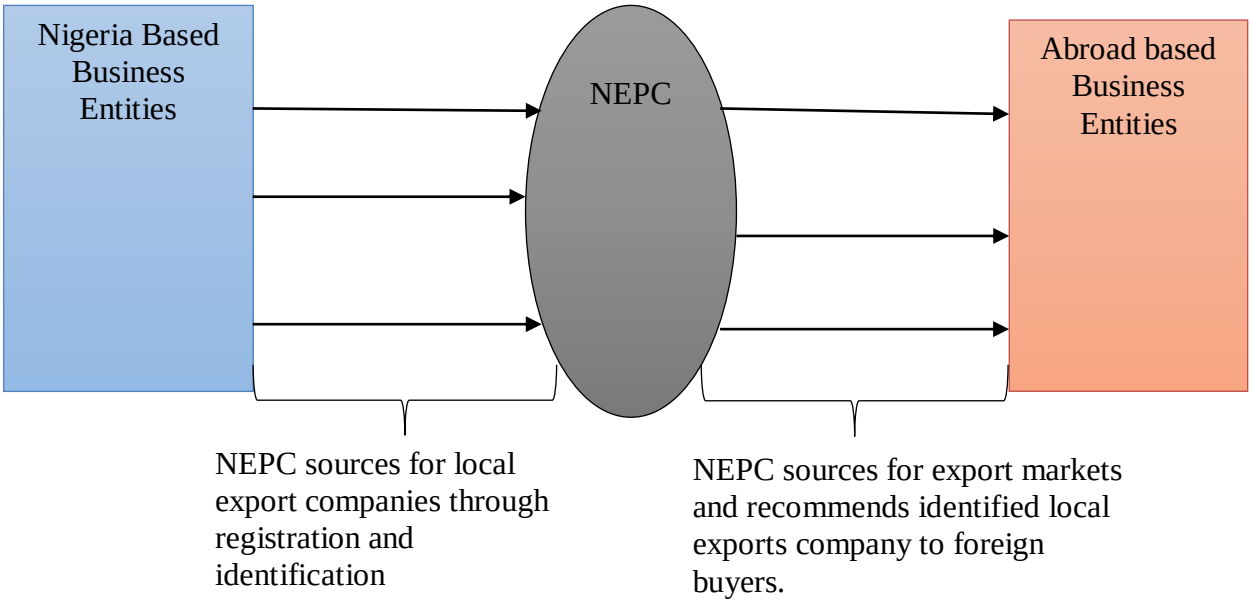


Figure 2. B2B model of the proposed system

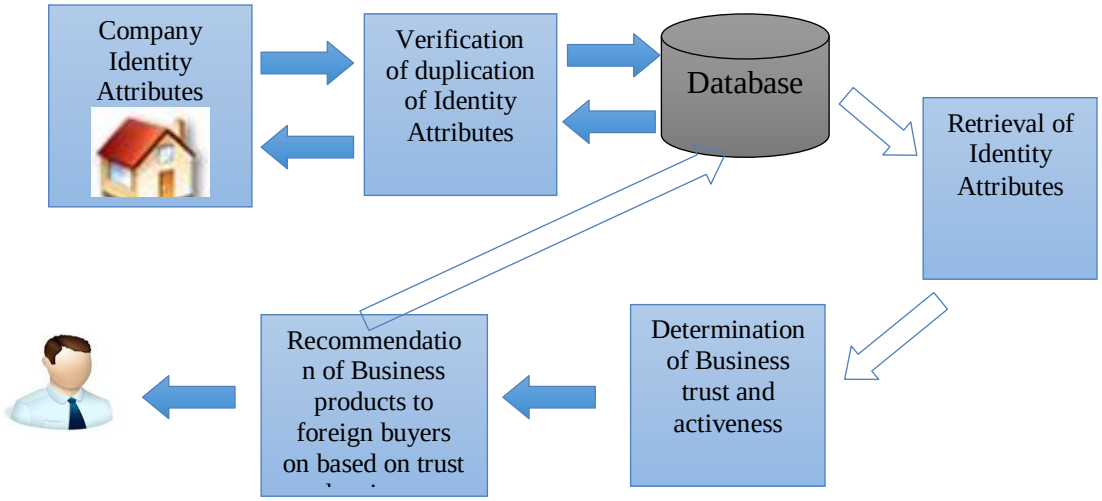


Figure 3. Conceptual model of the proposed system

Figure 4. The Fuzzification and Defuzzification process of B2B export dataset

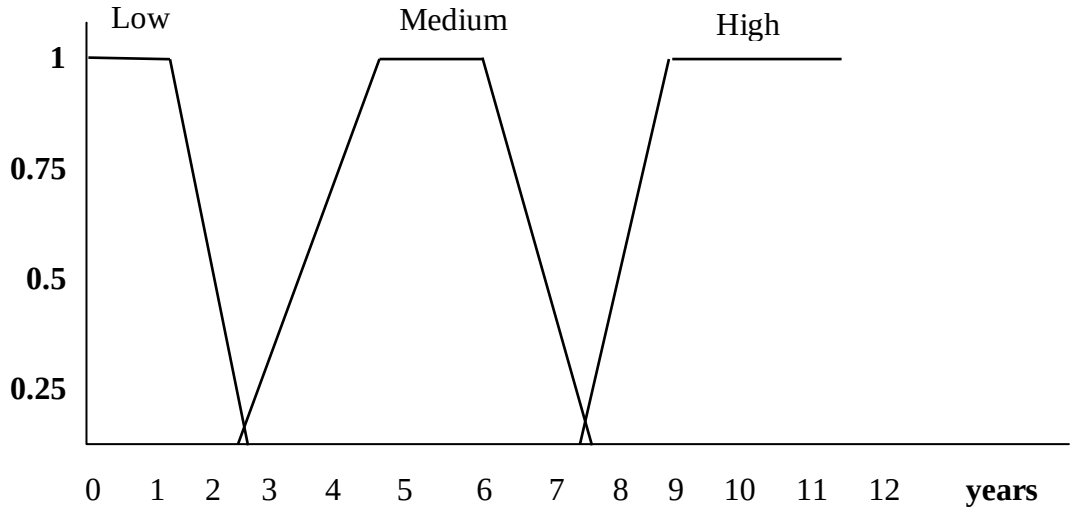


Figure 5. Operation-Duration membership function

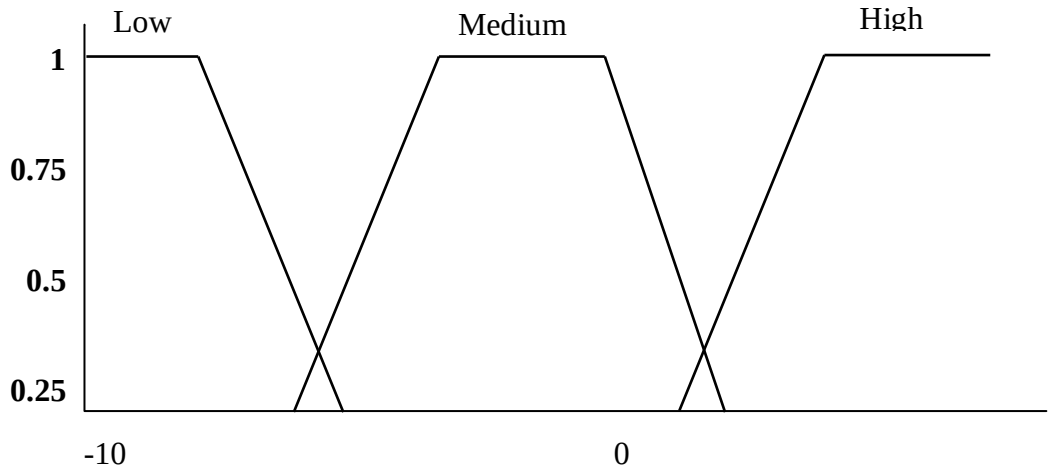


Figure 6. Change-in-tax membership function

Table 3.1: Inference rules for Fuzzy logic control matrix

Change-in-Tax / Op-Duration	**LOW**	**MEDIUM**	**HIGH**
LOW	Low	Low	Medium
MEDIUM	Low	Medium	High
HIGH	Low	High	High

Table 4.1: Unique identification data

S/N	**IDENTIFICATION**	**SOURCE**	**STATUS**
i.	Corporate Registration Number (RC)	CAC	Business
ii.	**Bank Verification Number (BVN)**	**NIBSS**	**Business/Personal**
iii.	Export Permit Number	NEPC	Business
iv.	Company name	CAC	Business
v.	Company phone lines	Telecom	Business
vi.	Company e-mail	ISP	Business
vii.	Company Representative Identification	DL, Passport	Personal
viii.	**National Identity Number**	**NIMC**	**Personal**

Table 4.2: Non-unique identification data

S/N	IDENTIFICATION	SOURCE	STATUS
i.	Product information	Company	Business
ii.	**Year registered**	**NEPC**	**Business**
iii.	Due/renewal	NEPC	Business
iv.	Repatriation compliance status	NEPC, FMF	Business
v.	Exporter Verification	NEPC	Business
vi.	**Tax compliance status (P & C)**	**FIR**	**Business**
vii.	Passport Photograph	Photographer	Personal
viii.	Signature	Personal	Personal

Table 4.3: Table relationship and output

S/N	EXPORTER (SELLER)				IMPORTER (BUYER)				TRUST LEVEL
	COY NAME	**CAC REG**	**TAX ID**	**YR REG**	**COY NAME**	**PROD.**	**QTY**	**VALUE (US$)**	
i.	AIG Stars	02920292	2827272	2008	Chin Chun	Sesame	5000MT	30,000	High
ii.	AIG GROUP	02920900	282900	2017	Rushy Holdings	Cocoa	50,000MT	80,000	Low
iii.	Mekus-Durham	0300000	430001	1998	Black Panther	Palm oil	330,000L	105,000	Medium

APPENDIX A

PHP CODES FOR FUZZY LOGIC

```
<?php
	function change_in_tax($prev_tax, $cur_tax){
		if($prev_tax > $cur_tax)
		{
			$tax_ch = "LOW";
		}
		else if($cur_tax > $prev_tax)
		{
			$tax_ch = "HIGH";
		}
		else
		{
			$tax_che = "MEDIUM";
		}
		return $tax_ch;
	}

	function operation_duration($year_est){
		$period = date("Y") - $year_est;
		if($period >= 5)
		{
			$oper_dur = "HIGH";
		}
		else if($period < 5)
		{
			$oper_dur = "LOW";
		}
		else
		{
			$oper_dur = "MEDIUM";
		}
		return $oper_dur;
	}
	//$tax_change =
	function Trust_Factor($prev_tax, $cur_tax, $year_est){
		$op_du = operation_duration($year_est);
		$tax_chg = change_in_tax($prev_tax, $cur_tax);
		if ($tax_chg =="LOW" AND $op_du == "LOW")
		{
			return "LOW";
```

```
                }
                if ($tax_chg =="LOW" AND $op_du == "MEDIUM")
                {
                        return "LOW";
                }
                if ($tax_chg =="LOW" AND $op_du == "HIGH")
                {
                        return "LOW";
                }
                if ($tax_chg =="MEDIUM" AND $op_du == "LOW")
                {
                        return "LOW";
                }
                if ($tax_chg =="MEDIUM" AND $op_du == "MEDIUM")
                {
                        return "MEDIUM";
                }
                if ($tax_chg =="MEDIUM" AND $op_du == "HIGH")
                {
                        return "HIGH";
                }
                if ($tax_chg =="HIGH" AND $op_du == "LOW")
                {
                        return "MEDIUM";
                }
                if ($tax_chg =="HIGH" AND $op_du == "MEDIUM")
                {
                        return "HIGH";
                }
                if ($tax_chg =="HIGH" AND $op_du == "HIGH")
                {
                        return "HIGH";
                }
        }
?>
```

OUTPUT PAGE (SELLER TRUST LEVEL)

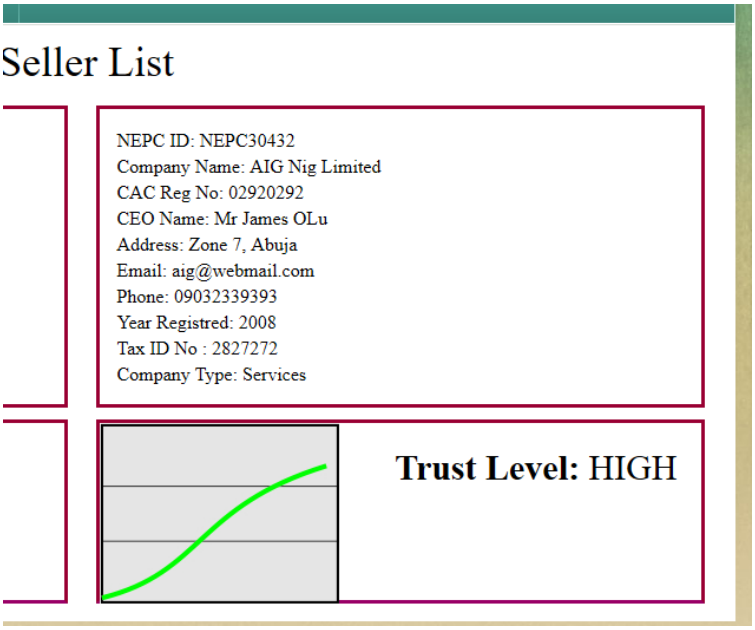
```
<?php
        session_start();
        include("processor/fuzzy-logic.php");
        if(isset($_POST["productBtn"])){
//              echo change_in_tax(2500, 2000);
                $tf = Trust_Factor(2000, 2500, 2010);
```

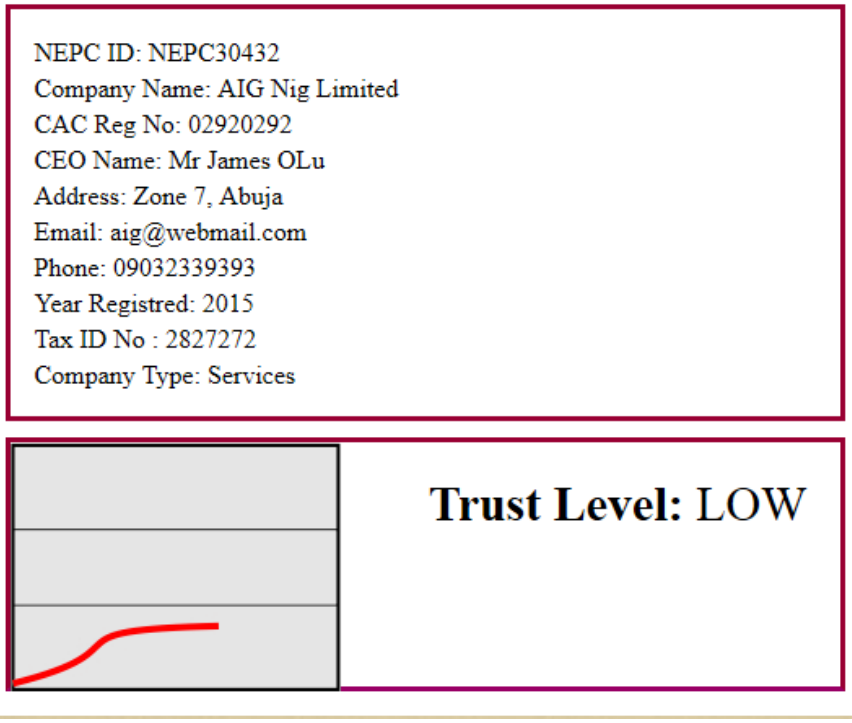
```
        $product = $_POST["productBtn"];
        $mysqli = new mysqli("localhost", "root", "", "b2bvalsysdb");
        if (mysqli_connect_errno()) {
                printf("Connect failed: %s\n", mysqli_connect_error());
                exit();
        }
        $query = "SELECT *  FROM registration where nepc_id = 'NEPC30432' ";
        $result = mysqli_query($mysqli, $query);
   if (mysqli_num_rows($result) > 0) {
     while($row = mysqli_fetch_assoc($result)) {
       $nepc_id = $row["nepc_id"];
                $CompanyName = $row["CompanyName"];
                $CACRegNo = $row["CACRegNo"];
                $CEOName = $row["CEOName"];
                $email = $row["email"];
                $Address = $row["Address"];
                $YearRegistred = $row["YearRegistred"];
                $phone = $row["phone"];
                $email = $row["email"];
                $TaxIdNo = $row["TaxIdNo"];
                $CompanyType = $row["CompanyType"];
     }
   } else {
     //echo "0 results";
   }
   mysqli_close($mysqli);
   $message = "You have not paid in Bank or Payment not yet activated!!!";
        }
?>
<!DOCTYPE html>
<!-- Website template by freewebsitetemplates.com -->
<html>
<head>
        <meta charset="UTF-8">
        <title>Land Legal Search System</title>
        <script type="text/javascript" src="css/js.js"></script>
        <link rel="stylesheet" href="css/style.css" type="text/css">
</head>
<body>
        <div id="background">
                <div id="page">
                        <div id="header">
                                <?php include("include/header.php") ?>
```

```
                <div id="navigation">
                    <?php include("include/navigate.php") ?>
                </div>
            </div>
            <div id="contents">
                <div class="seller-head"> Seller List </div>
                    <div class="seller-list">
                        <table width="100%">
                            <tr>
                                <td>

                                    <div class="seller" id="seller">
                                    </div>

                                    <div class="trust-div" id="trust-
div"> Timber </div>
                                </td>
                                <td>
                                    <div class="seller" id="seller">
                                        <div class="seller-info">
                                        <label>NEPC ID:  <?php
echo $nepc_id  ; ?></Label> <br />

                                        <label>Company Name:
<?php echo $CompanyName ; ?></label><br />

                                        <label>CAC Reg No:
<?php echo $CACRegNo ; ?></label><br />

                                        <label> CEO Name:
<?php echo $CEOName ; ?></label> <br />

                                        <label>Address: <?php
echo $Address ; ?></label>    <br />

                                        <label>Email: <?php echo
$email ; ?></label>    <br />

                                        <label>Phone: <?php echo
$phone ; ?></label><br />

                                        <label>Year Registred:
<?php echo $YearRegistred ; ?></label> <br />

                                        <label>Tax ID No : <?php
echo $TaxIdNo ; ?></label>  <br />

                                        <Label>Company Type:
<?php echo $CompanyType ; ?></label><br />

                                        </div>
                                    </div>
```

```
                                                    <div class="trust-div" id="trust-
div">
                                                    <img
src="images/image/high.jpg" />
                                                        <div class="tf" id="">
                                                        <Strong>Trust Level:
</Strong>
        <?php echo $tf ; ?>
                                                        </div>
                                                </div>
                                                </td>
                                            <tr>
                                        </table>
                                    </div>
                                </div>
                            </div>
                            <div id="footer">
                                <?php include("include/footer.php") ?>
                            </div>
        </div>
</body>
</html>
```

APPENDIX B
SAMPLE OF PROGRAM OUTPUT





Product Page

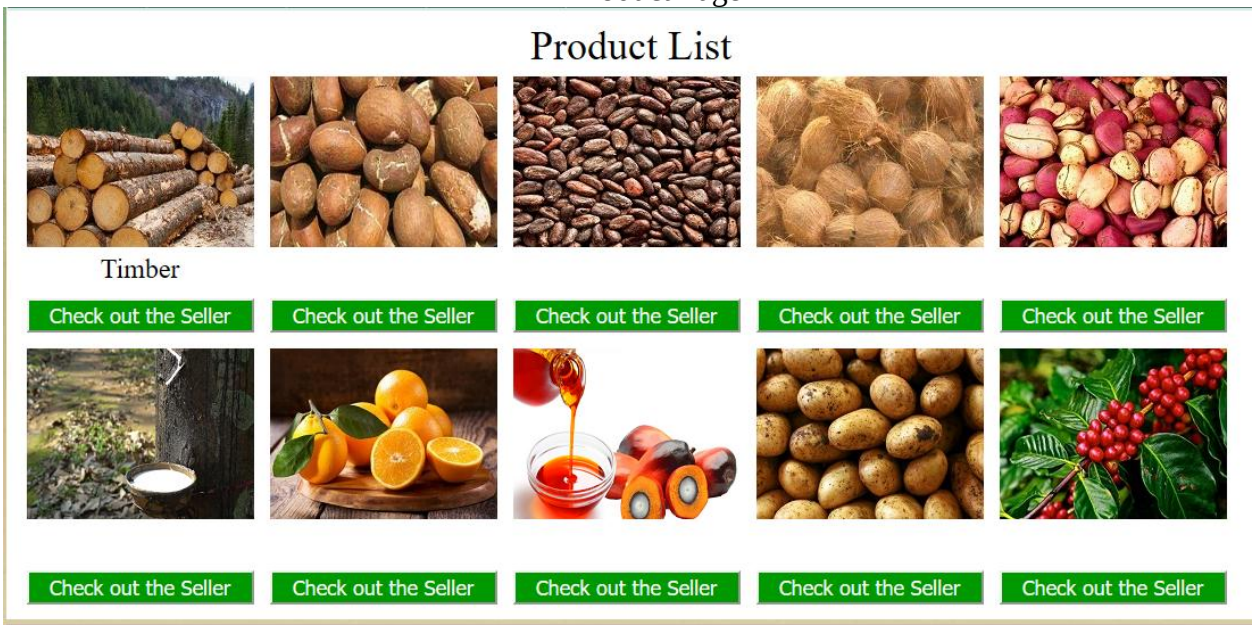
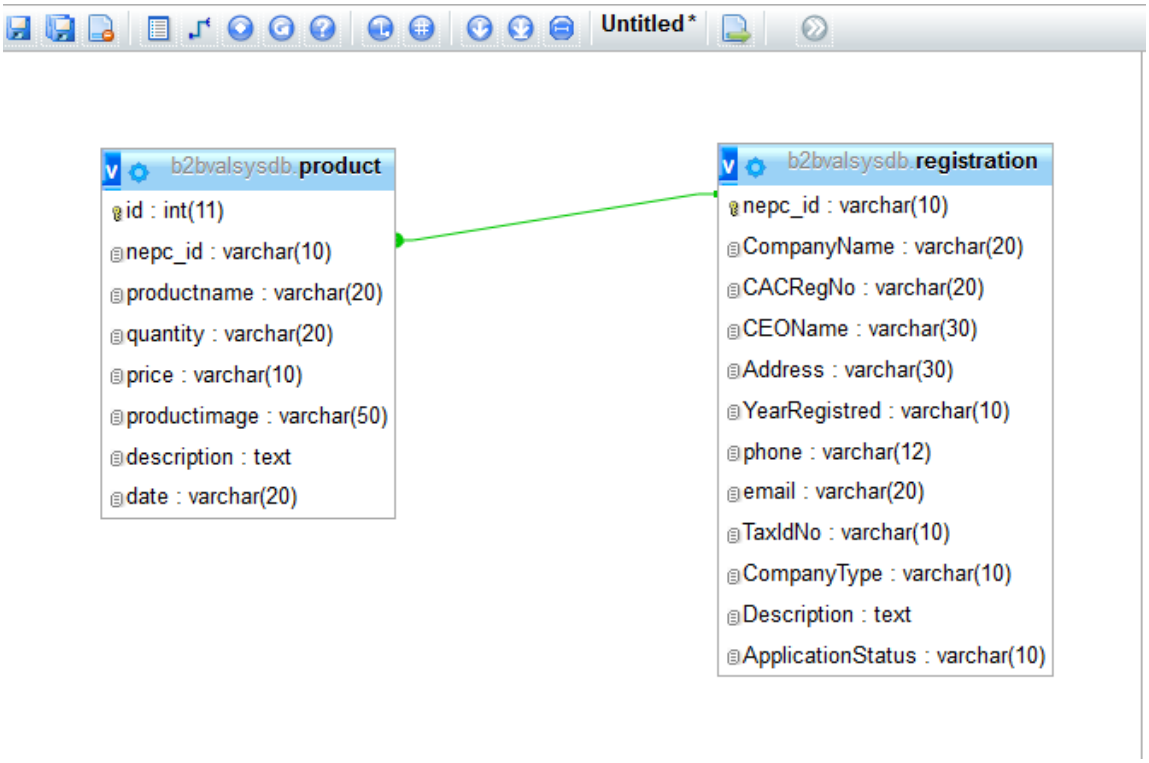
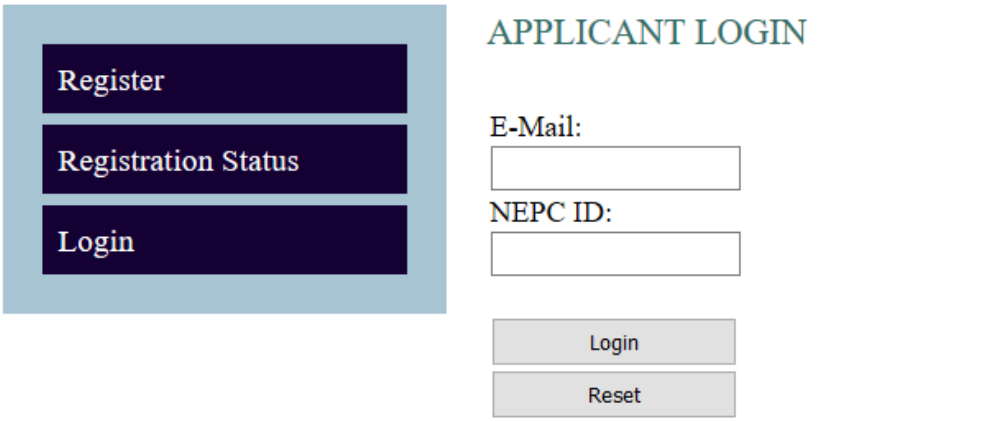


TABLE DESIGN and RELATIONSHIP



Application Login Form



COMPANY REGISTRATION FORM