

# **A Web Service Based Database access for Nigerian Universities' Certificate Verification System.**

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## **ABSTRACT**

*In recent times, research has shown that industries adopt distributed database system to improve their operations such as real time data exchange via remote database access. Traditionally, application connection to database is established using the database information such as database name, username, and password and IP address of the database server over a network. Studies in the past have shown that a number of security threats come to play in this approach as the database is exposed on that network. Much work has been done to tackle those threats but the proposed solutions huge processing. In this research a web-service-based remote database access method is proposed reducing the security threats by avoiding direct access. Another advantage of this approach is that it is platform-independent. An experimental case study of Nigerian Universities Certificate Verification System was designed and implemented using the proposed methodology.*

**Keywords: - Remote Database Access (RDA), Web Service, Certificate Verification.**

## **I. INTRODUCTION**

Certificate verification process is inevitable in most organisations as staffs are employed and ranked, students are issued admissions and scholarships based on the qualification they presented on certificates. Verifying certificate can be very tedious, some institutions outsource the process to a third party organisation. attempt to use IT technologies has been challenged as universities' will not allow third party organisations access their

database for verification processes, as a result the verification process remains partially or completely manual.

In this study a service oriented approach is used in collecting certificate data from universities and archive in a database central database which is further consumed for verification purposes. The proposed technique has three main modules as listed below (Figure 1):

- I. Data acquisition.
- II. Data processing.

### III. Data consumption.

**Data acquisition:** - module entails Universities publishing their certificate data based on a JSON template defined as shown in figure 2 for uniformity. Service URLs are stored in a table in the central database, URLs are queried and invoked sequentially to control concurrency in writing to the database. For records that have already been archived fields will be updated

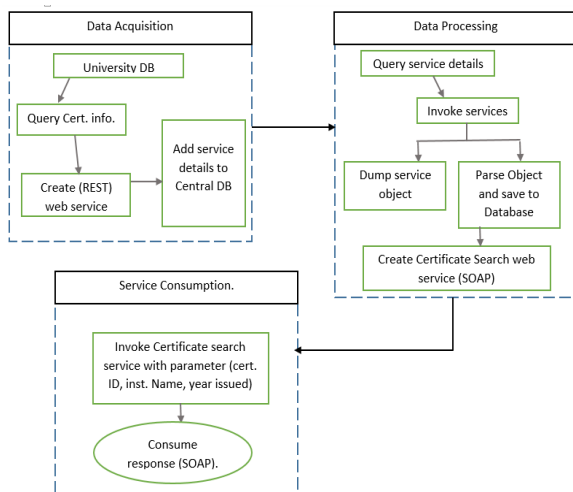


Figure 1. Research Methodology

```

    {
      "certid" = ""
      "dateissued" = ""
      "receiver" = ""
      "institution" = ""
      "Classofdegree" = ""
      "image" = ""
      "transcript" = ""
      "other" = ""
    }
  
```

Figure 2: JSON Template.

**Data Processing:** -Data processing module involves sequential invocation of certificate data services, replicate by dumping the JSON object in a dedicated JSON file, then parsed, content are then archived in the database in a de-normalised manner. A Search Web was implemented to search through the web service base on some search parameter provides invocation, these

**Data Consumption:** - Archived certificate data are consumed via the search service implemented at the processing phase.

This paper is divided into X sections. Section II discusses relevant literatures to the s

To establish the need for an effective and highly available system for certificate University verification system, some of the headlines of recent cases that were published in online dailies were recalled as follows:

On the 15<sup>th</sup> of February a news headline title “Alleged forged certificate: IGP orders investigation of Abia lawmaker”. “PDP Rep-elect loses seat over certificate forgery”, “800 Ogun teachers forged certificates, six thousand not qualified-education commissioner”. Forgery cases are gaining more popularity in dailies.

Some effort have been put in place to check the problem of certificate forgery like orientation of student on forgery at ceremonies such as matriculation and convocations. Making a forgery a punishable offence by the constitution. Some computer based certificate were adopted by few Institutions like Lagos state University. Other commercial website like ETX-NG, Qualification Check, and certificate validate.

## II. Related work

Electronic certificate verification system is a data driven system as its efficiency and turnaround time depends on the CIA security of certificate data from institution. Database access standardisation (ANSI/ISO/IEC 9579-1:1993) and (ANSI/ISO/IEC 9579-2:1993) define rules for database connection and access respectively. [1] Proposed a generic database service by replacing API's for accessing databases with web service reducing platform dependency in database access. The latter concept was used [2] to manage a database grid *Vince Service Grid* and improve on the query optimisation and data type enforcement with XML Schema.

Cloud computing has become the biggest change in IT after the rise of World Wide Web [3]. [4] Proposed the use of scalable private key for centralised database on the cloud. As security remains a challenge in database access. [5] Establish that a security solution must meet three requirement: confidentiality, integrity and availability. [6] Reported that 5% of the \$27 billion spent on security products directly addressed data security they proposed the use of multilayer security verification. [7] Proposed monitoring and analysis of data accessed by users to determine attack.

Validity of document has been threaten by forgery, [8] proposed encrypting and embedding information of device used it creating the document, on verification a decryption algorithm is used to verify the authenticity of the claimed document.

Electronic verification results are usually in human readable format such as PDF and HTML pages but not machine readable [9] Proposed a methodology for data

dissemination between Education information management systems (EMIS) in both human and machine readable format pdf and html, and XML through a web service respectively.

University certificate verification systems commercial available are numerous such as the Nigerian based *EXT-NG* and *Degree Validate* and international: *Qualification Check*

## III. Issues Of Remote Database Access And Certificate Verification System

The security setback of the [1] and [2] database information such as the schema of the database would have to disclosed to the accessing party, for [7] and [8] the computation cost is expensive, additional problem to the latter, the device information used can be clown to forge a certificate. [9] Methodology suffers the schema disclosure and it is limited to data exchange between education information management systems.

Limitations of the existing systems are as follows

1. Manual verification:
2. Takes time.
3. Human interference in the verification process.

This study propose a methodology where all information about the database is completely unknown to the consumer of the data. Data are retrieved from database through method invocation with the querying parameter as argument for function call via a web service.

## IV. IMPLEMENTATION

The concept was implemented in modules as discussed in section I.

Data Acquisition (University) Module: this is the certificate data source, this module collects necessary data from the university database and publish it on web service based on the JSON template shown in figure 2

Data processing (Certificate data warehouse): services of multiple university certificates data are sequentially invoked, resulting JSON responses are replicated, and parsed into central database. A web service for searching the through the central database to verify a claimed certificate providing search parameters as argument for invoking the search services.

Data consumption (End user): this is platform independent, the search service can be invoked form any platform provided all parameters for the search service are provided.

#### 4.1 The University Module.

**Database:** A relational database is assumed to be the most used type of database in Nigerian academic Institution, therefore MySQL database was considered for the universities database simulation hosted on an Apache Localhost server through the WAMP (Windows Apache MySQL PHP) package. Database was implemented and was populated with 20 synthetic records, this was done for three virtual University database shown in figure 3.

Java was the programming language used for the benefits of it APIs, libraries and security on the web. A connection was established using the java JDBC and MySQL connector jar file. An SQL query was executed to retrieve relevant information from the database. Results are parsed and presented in a JSON format using the GSON jar file and JSON library

functions. A REST web service was created on GET method the JSON object will be generated and served as service response. The REST approach offers a flexible response and the JSON was selected because according to [10] research parsing JSON file is faster than xml file format and requires less infrastructure.

#### 4.2 Certificate Data Warehouse (Data Processing)

Certificate warehouse: database in this module stores records of two vital entities the universities and their certificate information. Universities that are willing to give information will publish on a web service based on the specified JSON format, such University will provide the service URL and it will be appended that University's record for data retrieval for University database. Three things involved in the certificate data processing and warehousing includes:

1. University record.
2. Certificate data collection.
3. Certificate search service.

University record stores basic University information such as the University code, name of the University, web service URL and its dedicated replication file where data is replicated. Certificate data collection is done by invoking individual University services, response are parsed and archived. Certificate search allows searching for a record.

Java was used for implementing this module for similar benefits with the GSON, an update method was implemented for sequential update as describe in figure 3. Affected universities are queried, from the query result, web service URL for each University will be

invoked. The resulting JSON response is appended to the University's dedicated .JSON file which directory is defined in the University's record. This JSON file is a fault tolerance strategy as it serves as a backup which could be used to restore the data in case of any failure. The JSON object after replication is parsed and the element are used to generate a query that will insert them in to the certificate table. The University table has a last update field which captures the last time an update was made from that University.

Oracle database was engine was the platform chosen for its enterprise features and java compatibility. The archive could be achieved using any database engine of choice. Time for last update is recorded in the database for update tracking audit trail.

#### 4.3 The University Module.

Finally it is the search method which is the core function of the system, a user from any platform will invoke the search function via a web service, this service unlike the previous services is SOAP base service defined with a WSDL, the benefit of this is its strongly type. The response and request has been standardize, this will improve usability as all developers would not need a guide to consume the service, only one certificate can verified at a time, therefore the size is no much to be truncated or slow consumption of web service. The search method takes three arguments to search for a certificate which are certificate ID or number, Institution code, year of issuing certificate. A query is generated and executed to retrieve the defined certificate, the result is parsed in to SOAP format defined by the WSDL and publish as response for the search service. The diagram in figure 3 shows a logical description of the method

## V. EXPERIMENT & RESULT

### Environment setting

The experiment was carried out by simulating the three database servers on different computers hosting 20 certificate records each, the certificate warehouse server on a separate device, and a device invoking for testing the service. All computers were on the same local network with unique IP addresses and port number.

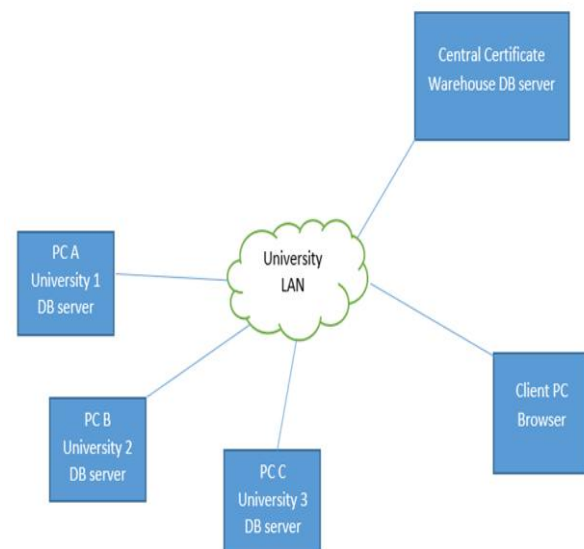


Figure 3: Experiment Environment

The experiment was executed in the following phases:

Phase I- launching University certificate service: this was executed in the following steps:

1. Connect system to the network.
2. Start MySQL server (WAMP) server.
3. Start eclipse IDE and run web service code as server.

The above steps will be repeated for computers hosting the certificate data. Each will the fetch and format certificate

data for individual University and publish it on web service.

Phase II- collecting certificate data, this was done in the following steps:

1. Connect to the network.
2. Start oracle server.
3. Run eclipse
4. Execute the update method: for data collection and processing.
5. Generate SOAP web service and client on the search function



Figure 4: JSON response from Service invocation.

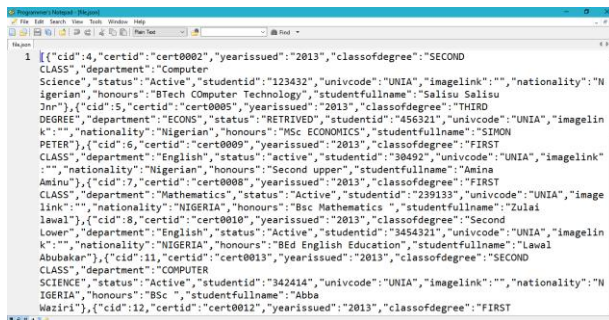


Figure 5: Archived JSON Object, after invocation.

Figure 4 shows the JSON response received after invoking a university web service, and 5 JSON file replica of the response from university certificate invocation.

Phase III- user: after connection to the network, the auto generated client URL will be used to invoke the web service,

pass parameter required and get the response on a web browser.

This XML file does not appear to have any style information

```
<certificate>
  <certificate cid="144">
    <certificateID>cert0002</certificateID>
    <yearofissue>2013</yearofissue>
    <classofdegree>SECOND CLASS</classofdegree>
    <department>Computer Science</department>
    <status>Active</status>
    <studentid>123432</studentid>
    <Unicode>UNIA</Unicode>
    <Image/>
    <Nationality>Nigerian</Nationality>
    <honours>BTech Computer Technology</honours>
    <fullname>Salisu Salisu Jnr</fullname>
  </certificate>
</certificate>
```

Figure 6: Certificate Verification SOAP Response.

## VI. Conclusion

Certificate verification process involves contacting the issuing institution or subscribing to a third party with reliable communication channel with institutions, In this study, the limitations of the aforementioned approaches were identified and a web service based approach was proposed to replace the verification process by retrieving certificate data from institutions and archiving them in a database from which verification can be made eliminating security threats and human error.

## VII. Recommendation

1. Use of more realistic experiment environment: the performance of the system cannot fully established if the size of data is large running on in the internet.
2. A NoSQL platform should be considered for the warehousing
3. Use of parallel algorithm for data update to improve the throughput during data collection.

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