

Integration of RESTful API to Student Information System for Secured Data Sharing and Single Sign-on

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Abstract—Growth in the usage of REST APIs has been witnessed in recent years. Many businesses and companies, such as social media sites and online services, used API to interoperate with other benefits. REST was considered the most logical, efficient, and widespread standard in the creation of APIs. Hence, the main focus of the study is to develop a Web-Based Student Information RESTful API. This paper utilized the incremental model in the development of the system. A survey was used to validate the problems encountered in acquiring student information and determine the software quality based on ISO 9126 software quality metrics. Survey questionnaires were distributed to the system developers as the study respondents following the total population sampling technique. A five-point Likert scale was used to quantify the survey result and weighted mean to analyze and interpret the result. Based on the analysis and interpretation, the system developers recognized that the system is Acceptable with an average weighted mean of 4.44. This study also developed a profiling system that is connected to the Single Sign-On (SSO) API. The profiling system serves as the data source of student information of the REST API. Besides, the portal and the REST API were utilized by various information systems such as ID Generation Management System (SIGS), Event Management System (EMS), Faculty Performance Evaluation System (FPES), and Smart Card-based attendance and monitoring.

Index Terms—RESTful API, Unified Student Information, Single Sign-on

I. INTRODUCTION

In recent years, API has been widely recognized in businesses and web services. All industries use APIs or application program interfaces as a vital tool in securely sharing the data and information to other services. It allows enterprises to innovate and develop new ideas by sharing existing data and information. Several API types emerged, one of which is REST or Representational State Transfer [1] [2]. REST or REST API is a web service architecture that offers a communication link between online platforms or systems. REST API is a norm used to build a network-based software system as an architectural instrument. In REST API, data are being transferred using the HTTP Protocol that is cost-effective in terms of internet traffic and in a way that is easy to use.

Maleshkova et al. [3] stipulated that the utilization of REST APIs still necessitates manual undertakings, which is the development of a static system suited only for a specific process and hard to be reused. However, the study of Wulf et al. [4], titled Service Innovation through Application Programming Interfaces - Towards a Typology of Service Designs, conceptualized APIs as an approach for service innovation that enables organizations to build digital platforms or to distribute data and applications. In support, Neuman et al. [5] also asserted that it has good support and technical features such as data formats, HTTP verbs, and URI structures. Besides, Heryandi [6] developed an API that enables the application to communicate with existing academic information systems and deliver a notification to the parent.

REST APIs have been utilized in various application fields; the study of Hsieh et al. [7], Nugroho et al. [8], and Risanen et al. [9] developed a RESTful API for ezCrum, Oil Palm Plantation Monitoring System, and IP Multimedia Subsystem, respectively. These studies used the standard HTTP methods known as verbs to represent operation in retrieving and appending resources and generating JSON String results. REST API was also utilized in information systems of colleges and universities, such as academic information [10], lecturer's assessment [11], e-learning [12], and dormitory monitoring [13].

Security [14] has also been an intrinsic part of RESTful API; the study of Huang et al. [15] presented a token-based user authentication mechanism for data exchange in RESTful API. In which every request in REST API will require a new unique token. In terms of session time, every API request will only be given a limited amount of time, and the token generation is shrouded during packet transmission. Also, Serme et al. [16] introduce a REST safety protocol to ensure stable service communication of REST API.

In a state college in the Philippines, rapid digitization of systems and processes has been observed over time. Student Information was being managed, accessed, and stored using an information system named Student Information and Accounting System (SIAS) by individual users, depending on the

administrator's permission. However, the College's pilot Student Information and Accounting System is outsourced, which causes barriers in reusing data and information to other newly developed information systems. Al-Alawi [17] stipulated that outsourcing's key drawbacks are lack of management control over outsourced activities, protection, confidentiality risks, quality concerns, hidden costs, and establishes' reassigned teams.

Currently, system developers of the state college access the student information by downloading an excel file generated from the system and consumes a lot of effort and time. Hence, the study's primary focus is to develop a Web-Based RESTful API for Student Information, which will benefit other information systems in sharing resources and connectivity to improve the delivery of all the college services digitally. Specifically, this study has the following objectives, (1) validate the problems encountered by the system developers in acquiring student's data; (2) develop a Web-Based Student Information RESTful API for data sharing and single-on; and (3) determine the software quality in terms of efficiency, functionality, reliability, usability, and security based on ISO 9126.

The developed software could help to alleviate the problems encountered in developing a system that uses student information. The software will not handle other information required by system developers. The system will solely control the personal information of Students. The system will also provide login authentication API to interoperated information systems. Accounts, tokens, and limits on sessions will also be issued to ensure the data's security.

II. METHODOLOGY

As this study is in line with software development, a software development methodology will be followed. Then part of the evaluation process will employ a descriptive-quantitative research method.

A. Software Development Methodology

In software engineering, the software development life cycle (SDLC) is a structure imposed on developing a product [18]. In this study, the researchers will utilize the Incremental Model [19]. In this Model, a first version of the software will be produced and incrementally adding functionalities to the previous release. This process will continue until the complete system is achieved. The incremental model includes four (4) phases: requirements, design and development, testing, and implementation.

- **Requirements.** In this phase, identification of system and device functional specifications will be carried out by the researcher.
- **Design and Development.** After the identification of requirements, the system functional design and the development process will be executed.
- **Testing.** After the successful development, the system will be tested according to the ISO 9126 software quality metrics.

TABLE I
FIVE-POINT LIKERT SCALE

Rate	Verbal Interpretation	Range
5	Highly Acceptable	4.6 – 5.0
4	Acceptable	3.6 – 4.5
3	Slightly Acceptable	2.6 – 3.5
2	Unacceptable	1.6 – 2.5
1	Highly Unacceptable	1.0 – 1.5

- **Deployment.** Once the system already passed the tests conducted, the system will be deployed and will be utilized.

B. Sampling Technique

The sampling technique will ensure that the respondents' population is adequate and will produce accurate survey results. Total Population Sampling will be used as a sampling technique such that the respondents have a particular set of characteristics.

C. Respondents

The respondents of this study are the faculty/developers who are developing institutional information systems. A total of 5 faculty/developers will validate the problems encountered in acquiring student data used in other institutional information systems. They will also validate the system based on ISO 9126 software quality metrics.

D. Software Quality Metrics

A questionnaire will be given to the respondents to validate the problems encountered in acquiring student information. Another to test the software quality. Analysis of the proposed method based on ISO 9126 software quality metrics [20] in terms of efficiency, functionality, reliability, usability, maintainability, portability.

E. Statistical Analysis

The collected data will be analyzed using descriptive statistics for the survey conducted to seek the problems being encountered by the developers. Evaluation of the software quality will use a Likert scale to quantify the survey result using questionnaires and statistically analyze using weighted mean.

F. Evaluation

Five-point Likert Scale [20] was used to measure the survey questionnaire's outcomes and evaluate and interpret the final result statistically shown in Table I.

III. RESULTS AND DISCUSSION

Since this study follows the Incremental Model, the result's discussion will follow the phases of the Incremental Model.

STUDENT PROFILE FORM

Student Profile Successfully Updated! ✕

Student Basic Information

SIGNATURE 	SAMPLE PICTURE 	PICTURE <small>NOTE: ONLY WHITE BACKGROUND WILL BE ACCEPTED FOR PRINTING</small> <small>Remove file</small>
STUDENT NUMBER 1200702	COURSE & YEAR BSIT 4A	ID STATUS FOR VERIFICATION
FIRST NAME Philip Alger	MIDDLE NAME Malagueño	LAST NAME Serrano
DATE OF BIRTH (YYYY-MM-DD) 1996-04-05	GENDER Male	CIVIL STATUS Single

Student Contact Information

CONTACT NUMBER 09506445813	
REGION Region I: Ilocos Region	
PROVINCE Ilocos Norte	
CITY/MUNICIPALITY Bacarra	
BARANGAY Buyon	
HOUSE NO. <small>Enter House No</small>	STREET RoadSide

Emergency Contact Information

EMERGENCY CONTACT NAME 95
EMERGENCY CONTACT ADDRESS RoadSide, Buyon, Bacarra, Ilocos Norte
EMERGENCY CONTACT NUMBER 09506445813

I hereby certify that the information above is true and accurate, otherwise payment is required for replacement of ID.

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Hand-crafted & made with Love

Fig. 1. Profiling Portal

A. Requirements

To validate the problems encountered in acquiring student information from the Student Information System, the researchers conducted a survey assessing the ways and medium on how to use student information in other information systems of the institution. The result of the survey shows that a hundred percent (100%) of the respondents perceived that the Student Information and Accounting System (SIAS) could provide data such as student information in exported Excel (XLS) or Comma Separated Values (CSV) format. However, a hundred percent (100%) of the respondents are not satisfied with the SIAS method, exported XLS/CSV in acquiring these data. Respondents also encountered problems obtaining these data, such as encoding special characters such as "ñ", formatting, whitespaces, level of authorization, and the system's non-disclosure of the database itself authorities. Respondents also suggest that these problems could be improved by sharing the database or developing a REST API.

B. Design and Development

With the problems stated in the requirements, the web-based API's functionalities have been identified by validating these problems to the respondents. One of the difficulties encountered is the non-uniformity of characters and formats

of student information in the Student Information and Accounting System (SIAS) hence, the researchers also developed a profiling portal for students, as shown in Figure 1. The profiling portal is connected to the Single Sign-On (SSO) of the College, allowing students to log in using their institutional email provided by Google Services. The profiling enables the student to update their information such as signature, personal information, photo, etc., anytime and anywhere. The profiling portal will be the source of web-based student information API.

In the design and development of API, CodeIgniter 4 was used to build the REST API. CodeIgniter is an Application Development Platform-a toolkit. CodeIgniter allows developers to build projects much faster than you might by providing a rich collection of libraries for commonly required tasks, as well as a simple interface and logical framework for accessing these libraries if you were writing code from scratch.

C. Process of API Request

Shown in Figure 2 is the graphical representation of the API request process, the administrator will provide an encrypted application and secret key to the client application. The application and secret key will be the unique credentials by the client application in order to login through the API Auth when requesting to the API. When the given credentials



Fig. 2. API Process

was validated by the API Auth, the request will then be processed to the API by getting student information through the profiling server. Once the required information was ready to be released, the API Auth will return back the requested information together with the access token.

D. API Functionalities

In this section, the RESTful API will be discussed. RESTful API consists of various request format such as the following:

- **Information by Email.** API Client could get the student information by sending a request through the student's email address. The API will send back the student information and photo in base64 image format shown in Figure 3.
- **Information by Student ID Number.** API Client could also get the student information by sending a request through the student's ID number. The API will also be sent back to the student information and photo in base64 image.

E. Testing and Evaluation

The researchers conducted various tests on the system using the ISO 9126 software quality metrics in efficiency, functionality, reliability, usability, maintainability, and portability. Based on the survey result shown in Table II in terms of Functionality and Portability, the system is highly acceptable with a weighted mean of 4.92 and 4.75, respectively, that means that the system and the REST API perform the tasks required, prevent unauthorized access, and can comply with portability standards. In terms of Efficiency, Reliability, Usability, and Maintainability, the respondents perceived that the system and REST API is acceptable with a weighted mean of 4.5, 4.25, 4.12, and 4.12, respectively, which shows that the system and REST API respond quickly, capable of handling errors, can be used without much effort, can be easily modified and can be easily moved to their environments. Overall, the respondents recognized that the system is Acceptable with an average weighted mean of 4.44, which manifests that the system performs all the expected functionalities determined in the requirements phase and is recommended for utilization.

F. Deployment

The Camarines Sur Polytechnic Colleges utilized the Web-based Student Information REST API on September 21, 2020. The REST API was integrated into ID Generation Management System (SIGS) [21], Event Management System (EMS),

TABLE II
EVALUATION RESULT

Classification	Weighted Mean	Interpretation
Efficiency	4.5	Acceptable
Functionality	4.92	Highly Acceptable
Reliability	4.25	Acceptable
Usability	4.125	Acceptable
Maintainability	4.125	Acceptable
Portability	4.75	Highly Acceptable
AVERAGE	4.4	Acceptable

Faculty Performance Evaluation System (FPES), and Smart Card-based attendance and monitoring.

IV. CONCLUSION

Growth in the usage of REST APIs has been witnessed in recent years. Many businesses and companies, such as social media sites and online services, used API to interoperate with other services. REST was considered the most logical, efficient, and widespread standard in the creation of APIs.

This study investigates the problems being encountered by the system developers in acquiring student information at Camarines Sur Polytechnic Colleges. The issues encountered were validated by conducting a survey on what they currently perceived in developing student information through the Student Information and Accounting System (SIAS).

Upon validation, the result shows that a hundred percent (100%) of the respondents perceived that the Student Information and Accounting System (SIAS) could provide data such as student information in exported Excel (XLS) or Comma Separated Values (CSV) format. However, a hundred percent (100%) of the respondents are not satisfied with the SIAS method, exported XLS/CSV in acquiring these data. Respondents also encountered problems obtaining these data, such as encoding special characters such as "ñ", formatting, whitespaces, level of authorization, and the system's non-disclosure of the database itself authorities. Respondents also shared some possible actions to alleviate these problems by sharing the database or developing a REST API.

Hence, the researchers developed a profiling system that gathers student data such as photos, signatures, and other student information by following the incremental model as the study's software development methodology. The system was also linked to the Single Sign-On API of the College using the official institutional email. The system could also provide a REST API that offers various request services such as information by email, Student ID number, and others.

To validate the system's software quality, the researchers initiated a survey of the system developer of the College. The system was evaluated based on ISO 9126 software quality metrics in terms of efficiency, functionality, reliability, usability, maintainability, portability. Based on the survey result, most system developers recognized that the system is Acceptable with an average weighted mean of 4.44. Accordingly, the Camarines Sur Polytechnic Colleges utilized the Web-based Student Information REST API on September 21, 2020. The REST API was integrated into ID Generation Management

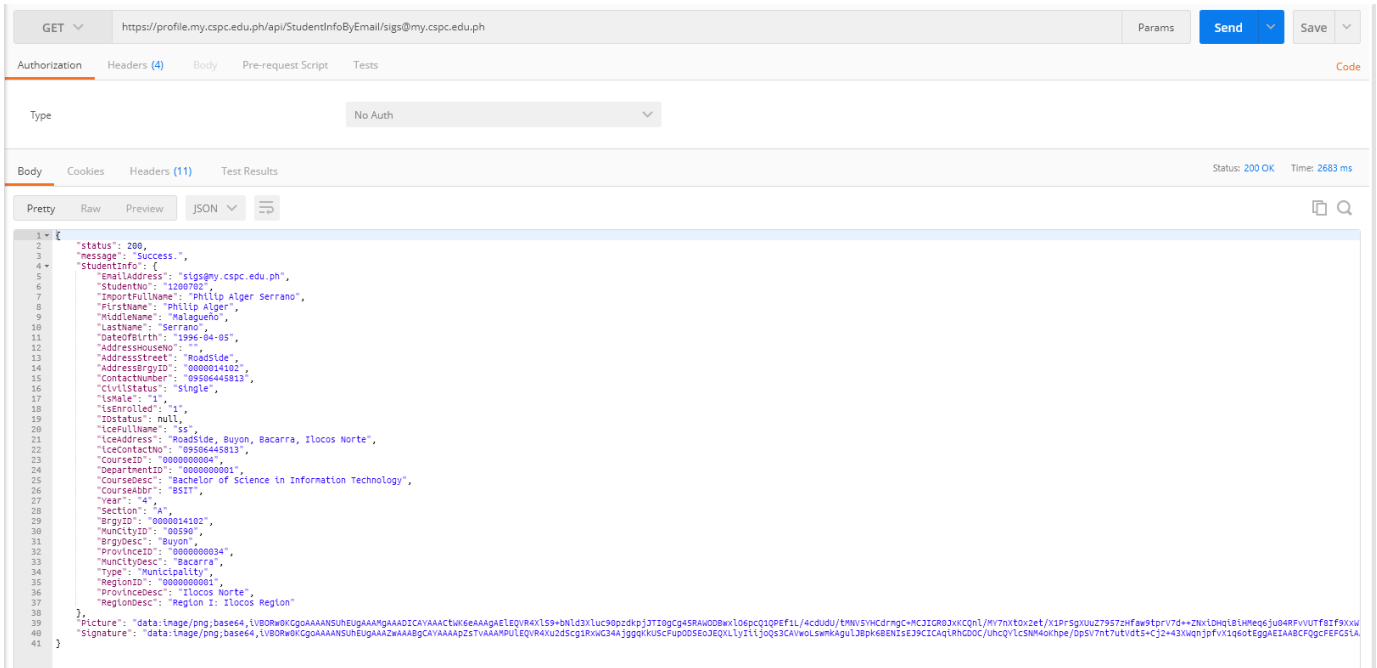


Fig. 3. API Result by Email

System (SIGS), Event Management System (EMS), Faculty Performance Evaluation System (FPES), and Smart Card-based attendance and monitoring.

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