Web Service for Academic Information Systems

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Abstract. This research has the goal of creating an academic information system based on web service or Application Programming Interface (API). We use API, so that information systems are easily accessed and applied to cross platforms such as websites, desktop applications, mobile applications, and others. The descriptive analysis method was used in this study to analyze the requirements contained in the built system. Other than that, we used the waterfall method as a model approach in software development. The final results of this study can help in the management of academic data. These results can be achieved because all information is processed and presented online and accessed through cross platforms. Besides, if universities are advanced, this system is more comfortable to develop because it uses the API. Hopefully, this research result can contribute to the Ministry of Research, Technology, and Higher Education data management regulation.

1. Introduction

The education field is now becomes more competitive, where competition for the implementation of educational institutions is increasingly stringent. It is characterized by efforts to improve the quality of teaching, research, provision of facilities, and human resources. Relationships of cooperation with various institutions or companies both at home and abroad also become a competition. The ability to provide services will significantly build the image of the institution becoming more trusted. Information services that can be accessed directly by the students will undoubtedly have a positive impact on educational institutions in an intense competition now. Academic information systems equipped with web service based database systems are information systems that are large and complex enough to be implemented [1].

Previously there have been similar studies conducted by Effendi, Purnama, and Eka regarding the academic information service system based on Short Message Service [1] and conducted by Indrayani that study about Management of higher education academic information systems based on Information and Communication Technology (ICT) [2]. However, none of their research has applied the concept of web service. Therefore, the system created cannot be maximized if it is to be applied to the cross platforms. Research on web services has also been carried out by Raafat George Saadé [3], Jason H Christensen[4], David Jones, Shirley Gregor, Teresa Lynch [5], and Hatem Hamad, Motaz Saad, as well as Ramzi Abed [6], however their studies were not applied to the academic information systems.

This research has the goal of creating an academic information system that implements web service so that if the system is implemented in many platforms, it will be more maximal and there is not much work to be done. The descriptive analysis method was used in this study to analyze the requirements contained in the system to be built while the waterfall method is used as an approach model in software development.
2. Method
The descriptive analysis method is used to analyze the requirements contained in the system to be built. A descriptive analysis method is carried out to find out the existence of independent variables, both on one variable or more (stand-alone variables) without making comparisons and looking for the relationship of the variable with other variables. Whereas in the approach model the software development used the Waterfall method. It will go through several stages and must be done sequentially, namely the initiation, system design, implementation, integration and testing stages, as well as the final stage.

3. Results and Discussion
At present, almost all educational institutions have a website [7]. The web has various purposes, such as the web for information, promotions, and registrations. The web information system is the most complicated web because it has many objectives, namely, to manage all students and the variables of each student. These variables include the student’s mark, class, curriculum, syllabus, attendance, biodata, and online lectures. The larger of the educational institution, the bigger and more complex the web they have. To overcome this, we need to use a web service concept. In the concept of web service, there is something called the REST API method [8,9]. REST (REpresentational State Transfer) means a server that exchanges documents with a client over HTTP.

In the REST architecture, the REST server provides resources and the REST client accesses as well as displays the resource for future use. Each resource is identified by URIs (Universal Resource Identifiers) or global ID. The resource is represented in the form of text format, JSON, or XML. Generally, the format uses is JSON and XML.

The REST API has a better version called the RESTFul API. By using the RESTful API, the website can be accessed from various devices and platforms. The following is an illustration of the REST API Connection as in Figure 1.

![Figure 1. REST API Connections.](image)

From Figure 1, it can be seen that various platforms can be connected without problems. One database can be accessed by mobile, web, and legacy applications. It is because the REST API can be accessed from across platforms, applications that use the REST API can also be made using various programming languages as seen in Figure 2.
The striking difference between websites that use REST and non-REST is the URL. Websites that use REST will have a shorter URL. If examined more closely, the difference in URL is caused by the HTTP method or HTTP verb used. Non-REST websites only use HTTP POST and GET methods, while the REST website uses all available HTTP methods such as GET, POST, PUT, DELETE, and others[10]. An explanation of the HTTP methods commonly used by REST can be seen in Table 1. Differences in REST and non-REST websites on URLs can be seen in Table 2 and Table 3.

Table 1. HTTP Method.

| HTTP Verb | Function                                              |
|-----------|-------------------------------------------------------|
| GET       | Used to read resources from the REST server           |
| POST      | Used to create new resources on the REST server       |
| PUT       | Used to renew resources in the REST server            |
| DELETE    | Used to delete resources from the REST server         |
| OPTIONS   | Used to get operations that are supported on resources from the REST server |

Table 2. REST website URL and HTTP verb.

| Route Name | Description                                      | URL             | HTTP Verb |
|------------|--------------------------------------------------|-----------------|-----------|
| Index      | Display a list of all students                    | /students       | GET       |
| New        | Show form to add new students                     | /students/add   | GET       |
| Create     | Add new students to database, then redirect       | /students       | POST      |
| Show       | Show info about one student                       | /students?id=:id| GET       |
| Edit       | Show edit form of one student                     | /students/id/edit| GET       |
| Update     | Update a particular student, then redirect         | /students?id=:id| PUT       |
| Destroy    | Delete a particular student, then redirect         | /students?id=:id| DELETE    |

Table 3. non-REST website URL and HTTP verb.

| Route Name | Description                                      | URL             | HTTP Verb |
|------------|--------------------------------------------------|-----------------|-----------|
| Index      | Display a list of all students                    | /students       | GET       |
| New        | Show form to add new students                     | /students/add   | GET       |
| Create     | Add new students to database, then redirect       | /students/add/save| POST      |
| Show       | Show info about one student                       | /students?id=:id| GET       |
| Edit       | Show edit form of one student                     | /students/edit?id=:id| GET       |
| Update     | Update a particular student, then redirect         | /students/save  | POST      |
| Destroy    | Delete a particular student, then redirect         | /students/delete?id=:id| GET       |
In one educational institution, there must be many websites that refer to the main website. There are also third parties who want specific data on the main website. In this case, security will be at stake. However, REST can solve the problem. In the REST website, the data received is generally a JSON file. Besides JSON, it can also use text files or XML. Through this JSON file, a security key can be created. The security key is often referred to as the API Key. The API key can be categorized into two access rights namely private API key and public API key. Anyone can use the public API key but the data sent is not the important data while the private API key is used to obtain relevant data. Then for third parties who want to get data from the server must have a private API key. Figure 3 shows when a third party wants to access data on the server but does not enter the private API key. In Figure 4 is when entering the wrong API key.

![API Key required](image)

**Figure 3. API Key required.**
JSON files are not only used for the received data but also for the data sent. The output of the REST website is a JSON file. This is the reason why REST websites can be used by cross platforms and across programming languages. All programming languages can process JSON files. With this advantage, JSON can be used on Android, iOS, website, controller, and others. Examples of JSON results from students can be seen in Figure 5.

In addition to the form of a JSON file, the REST server also provides an HTTP response. HTTP response status codes have a function to indicate whether an HTTP request has been completed successfully. Response codes are divided into five categories: informational responses, successful responses, redirect, client errors, and server errors. Nevertheless, generally, only three categories used by the REST API are successful responses with 2XX code, client errors with 4XX code, and server errors with 5XX code. The code response commonly used in REST can be seen in Table 4.

Figure 4. API Key unregistered.

Figure 5. Output JSON of Student.
### Table 4. HTTP response status codes.

| Response Status Code | Function |
|----------------------|----------|
| 200 OK               | This code means that the request was done successfully. |
| 201 Created          | This code means that the request was done successfully, and the data has been made. This code is used to confirm the success of the PUT or POST request. |
| 400 Bad Request      | This code means that the request was made wrong or the data sent does not exist. |
| 401 Unauthorized     | This code means that the request made requires authentication before accessing the resource. |
| 404 Not Found        | This code means that the resource called is not found. |
| 405 Method Not Allowed | This code means that the request endpoints exist but the HTTP method used is not permitted. |
| 409 Conflict         | This code means that the request made is duplicated; usually the information sent is already there. |
| 500 Internal Server Error | This code means that the request made has a server-side error or resource. |

By utilizing the HTTP response, handling errors will be more natural because it can be read directly so that the client does not need to check the contents of the JSON file. The use of HTTP response when accessing the REST server can be seen in Figure 6.

![Figure 6. HTTP Response Usage.](image)

### 4. Conclusion

By utilizing the RESTful API to be applied to academic information systems will make it to be more efficient. Many non-REST websites cannot do things but can be done by the REST website. For example, in the development needs, it will make it easier for programmers to develop it. If there is a third party who wants data, there is no need to worry about security because it has used a private API key. RESTful is the best solution to be applied to the website of academic institutions.

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