Implementation of Microservice Technology on Mobile Learning Development

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ABSTRACT
Software development using microservice has many advantages over conventional technology. The short number of comprehension and applied examples of microservice technology have caused the software developed using this technology is confined. This research aims to apply microservice technology in the development of mobile learning (MLearning). Implementation of microservice will break the application into stand-alone entities and isolated with others. Thus failure in an entity will not effect the application as a whole system. This research using a mixture of quantitative and qualitative methods in collecting and analyzing data. The data obtained is modeled with an object-oriented approach by used Unified Modelling Language tool (UML). RUP method as one of software development method that gives focus to software architecture is used to develop the MLearning. By this research expected a MLearning is produced using microservice technology. It is expected this MLearning will improve the quality of education in Manado State Vocational High School. The conclusion of this research is that the development of MLearning with microservice technology will form a robust application that gives a positive impact on teaching and learning process at Manado State Vocational High School.

General Terms
Web development, Cloud computing

Keywords
Microservice,mLearning,entity,UML,RUP

1. INTRODUCTION
In the era of digital technology, the use of mobile devices become a necessity for both individuals and organizations to improve their performance. Mobile devices have become practical tool in accessing information and communication, so they are used in various fields the such as education, health, social and others. The rapid development of mobile devices is supported by the progress of innovation in both hardware and software. In the field of software, the proliferation of mobile applications such as eLearning, eGovernment, games have added software functionality and have an impact on the market demand for mobile devices that continues to increase over time.

According to Cavus & Ibrahim [2009], Mobile learning enables multimedia communication by deploying text, voice, video and graphics. It can be achieved by collaboration between mobile devices such as cell phones, laptops, PCs, PC tablets, PDS and other handheld device with wireless internet network. MLearning allows student to exchange messages, sounds, pictures and other rich correspondence among themselves utilizing internet. Sanchez [2015] says MLearning is any kind of learning that happens when the learner is not controlled by time and location. Mobile learning happens when the learner applies mobile technologies to absorp the learning materials. By using mobile learning students with various backgrounds even those with disabilities can take advantage of distance learning facilities.. Furthermore, mobile learning is equiped with some amazing features that can not be found on other equipments. These features include the ability to take and share images in real time, maps and GPS. Vasiliaou & Economides, 2011 conclude that mobile learning has served impressive educational and learning facilities by integration with wireless networks, mobile devices and other network technologies..

Software on a large scale is generally built in a distributed way and consists of various media connected in one network. In this context, microservice is a new software development pattern where the overall software functions are provided by smaller software components. These components use and provide software services and are developed by the team separately. Unlike traditional software development where the development team and operational teams are separate, in microservice each team provides all development and operational requirements for services or services built (DevOPs).

The picture below shows an example of a microservice consisting of five services that work together to provide applications for external users.

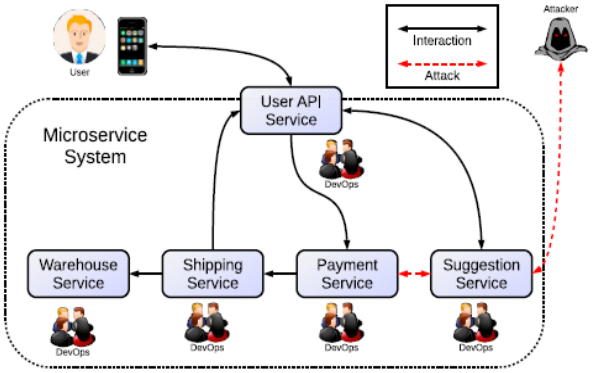

Figure 1: Microservice System

Users run client applications both mobile applications and web-based applications that access the external User API provided by the system. The service API is indeed an internall service that provides the requested function (warehause service, shipping serice, payment service, suggestion service). Each of these services is maintained by the DevOps team who develop, deploy and maintain the system.

As noted above, the development of software using microservice technology has many advantages compared to conventional technology. Lack of understanding and applied examples of microservice technology is one of the causes of the lack of software developed using this technology. This research aims to implement microservice technology in the development of mobile learning (MLearning). Application of microservice will break applications into entities that stand alone and are isolated from other entities. Thus failure in one entity will not affect the overall application

2. RESEARCH METHODOLOGY

The system development strategy utilized in the improvement of this application is Rational Unified Process (RUP). This strategy is utilized on the grounds that the time required in the advancement of this application is generally short and furthermore this application will encounter upgrades amid the improvement procedure.

Rational Unified Process (RUP) software development process that is most broadly utilized today by groups engaged with programming advancement (system analyst, project manager) (Qiali Chen, 2015).

RUP is a software engineering process with great definition and great organizing. RUP gives a decent meaning of structure for programming venture life stream. RUP has four phases or stages that should be possible iteratively. In this strategy there are four phases of programming improvement, in particular:

1. Inception; it is the phase of displaying the business procedure and characterizing the requirement for the framework to be made
2. Elaboration; more spotlight on arranging the framework design. This stage can likewise be made to decide if the coveted framework engineering can be made or not. This stage additionally underlines the examination of framework outline and framework usage and the normal outcomes from this stage are satisfy the turning point engineering lifecycle
3. Construction;this stage is more centered around creating segments or framework highlights.
4. Transition; this stage more on the sending or establishment of the framework with the goal that it tends to be comprehended by the client. Activities at this stage incorporate client preparing, support and framework testing whether they meet client desires.

3. RESULTS AND DISCUSSION

3.1 System Modelling

The building system can be seen in the following UML diagram (figure 2)..

3.2 System Architecture

The system architecture that is built refers to the functional requirements obtained from interviews with prospective users and utilizes references from literature studies. Functional requirements are arranged in table form (table 1) and consist of actor requirements and functional requirements. Actors are users who will use applications, namely administrators, teachers and students).

Table 1. Functional Requirement

ID	Aktor	Functional Requirement
001	Teacher	Make question
002		Edit & update question
003		Enter mark
004		Edit and delete mark
005		Make answer
006		Edit and delete answer
007		Input learning material
008		Edit and delete learning material
009	Admin	Input SMK data
0010		Edit and delete SMK data
0011		Enter lesson data
0012		Edit and delete lesson data
0013		Enter user
0014		Edit and delete user
0015	Student	Asses question
0016		Asses mark

The architecture of the microsystem service that is built is as in Figure 3. For the implementation of the microservice architecture using the lumen framework. Lumen is part of the laravel framework that is used to develop microsystem.

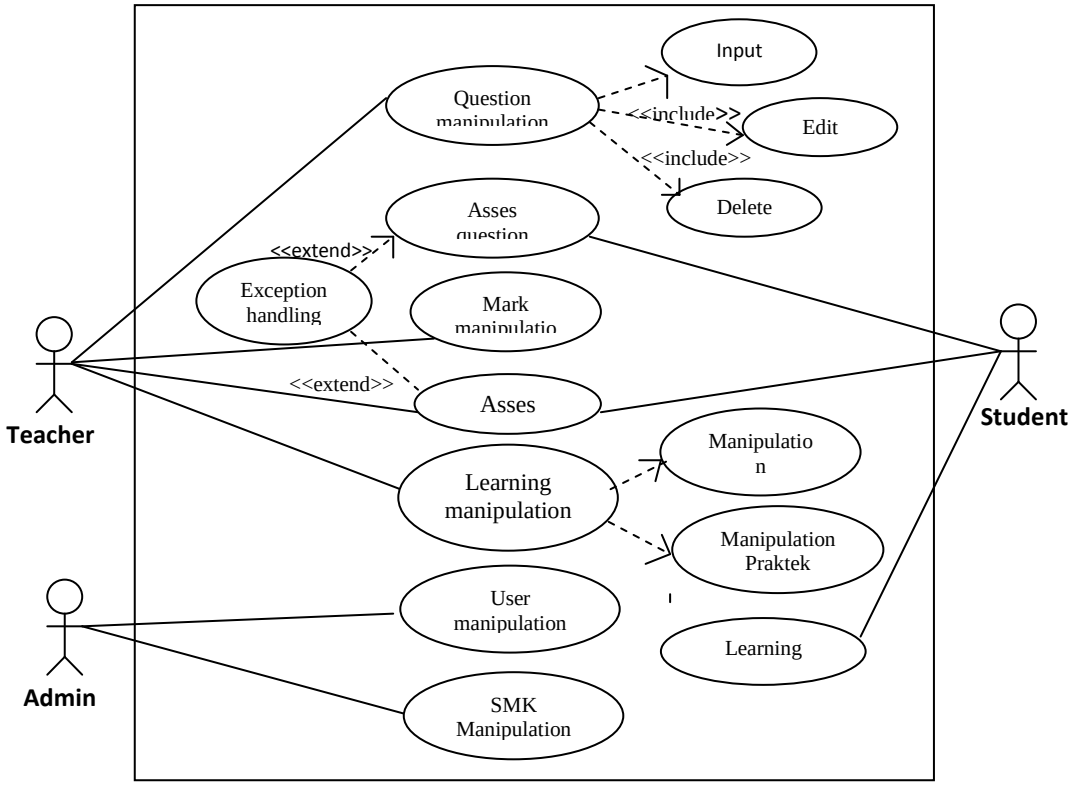

Figure 2: System Modelling

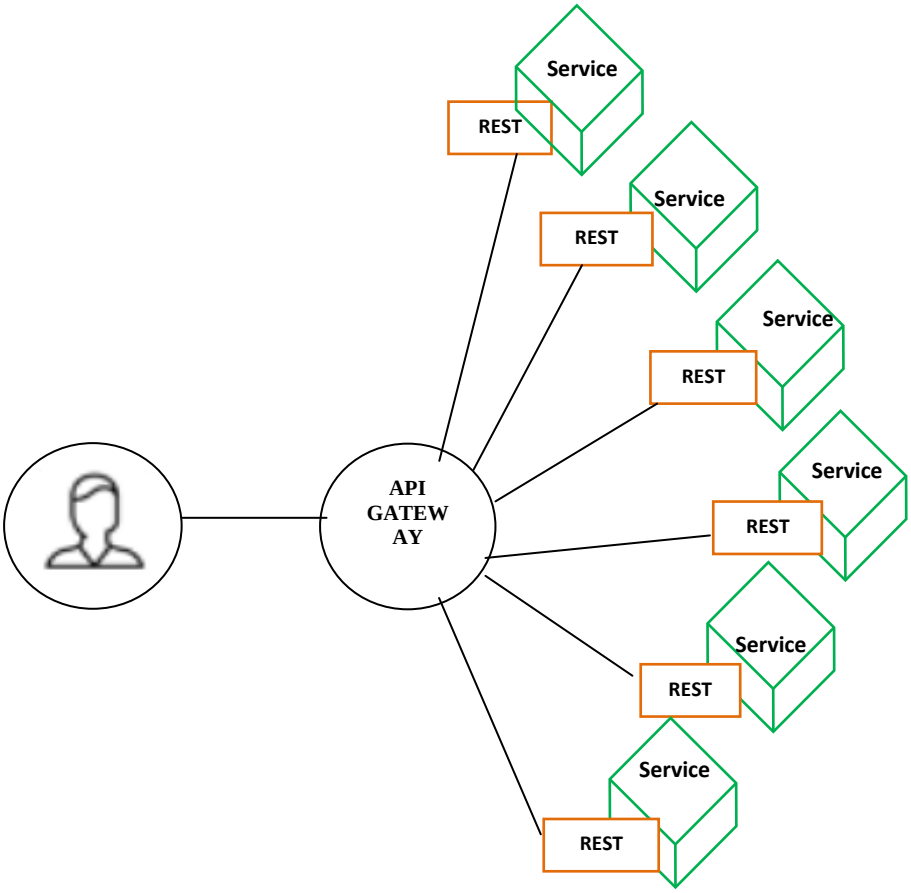

Figure 3: System Architecture

As shown in the picture above, all requests from users will go through the Gateway API which will then direct this request to a particular service . In addition, the Gateway API has role for the protocol translation and provides the custom API that users need. The gateway API provides an example endpoint (/ question? ProblemID = 101) so that users can access the question with ID number 101. Implementation of the Gateway API and some of the above microsystems can be seen in the following figure

Figure 4: API Gateway

3.3 System Testing

System testing in the form of functional testing is carried out to analyze the built-in microservice system. Testing functionality is one of the black box testing that is done to ensure that the system functions as it is modeled / expected. The results of testing functionality can be seen in the table below:

Table 2. Testing Functionality

No	Testing	Test Case	Expected Result
1	API Gateway Functionality	1. User enters the URL according to the desired REST API 2. User access the opened service	1. User can access the desired service 2. User can use service fiture
2	Mark microservice functionality	1. User opens form to input, edit and update mark based on certain parameter 2. User click submit button	1. Mark can be input, edit and delete based on certain parameter 2. Data is valid, data can be stored in database
3	Question microservice functionality	1. User opens question form to input, edit and delete the question 2. User click submit button	1. Question form is opened and question can be accessed 2. Validation is OK and question can accessed from database
4	Learning material microservice functionality	1. User opens learning form and input learning material 2. User chooses submit button	1. Learning function can be used 2. Learning material is stored into database
5	User microservice functionality	1. User open form to input, edit and delete data 2. User choose submit button	1. User can use the form 2. User data can be stored into database

4. CONCLUSION

The microservice architecture breaks applications into independent entities that are called through the Gateway API. The mobile learning application that is built has six micservices that can be developed as needed by adding certain services to the existing system. The effective lumen framework for building microservice and supporting the development of RESTFUL API applications

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