The use of Microframework for Portable and Distributed ePortfolio Development

Irwan Alnarus Kautsar
Department of Informatics,
Faculty of Engineering,
Universitas Muhammadiyah Sidoarjo
Sidoarjo, Indonesia
irwan@umsida.ac.id

Riyanarto Sarno
Department of Informatics,
Faculty of Information Technology,
Institut Teknologi Sepuluh Nopember,
Surabaya, Indonesia
riyanarto@if.its.ac.id

***Abstract*— ePortfolio is an essential tool used for track and evaluates the learning process. This paper presents the current development of a web-based ePortfolio system that has been developed with Microframework. ePortfolio commonly used as a tool to track and evaluate student's artifacts as a result of the course assignment. Furthermore, ePortfolio is needed for lecturers who have been implementing Project-Based Learning (PBL) and Lab-Based Education (LBE). On the other hand, the lack of internet access that still an issue in Indonesia as developing countries ePortfolio needs to be accessed in both online and offline conditions. The proposed method is to develop a web-based application using python based micro-framework. The web-based application is to enable users to use in offline condition (no internet access). As a result, a web-based application that will be used for both students and lecturers to upload and evaluate the uploaded artifacts and synchronize its contents to the existing University Information Systems. As part of the development process, the proposed ePortfolio has been tested on a mini device installed Access Point (AP). With this approach, lecture and student could use the web-based ePortfolio in the classroom with no internet conditions. Both users need to synchronize the artifact to the ePortfolio server in a distributed manner when the mini device is connected to the existing university ePortfolio.**

Keywords—ePortfolio, Higher Education Institution, Project-Based Learning

I. Introduction

The main goal of Industry 4.0 Strategic Initiatives that elaborated by the Ministry of Research, Technology and Higher Education (RTHEI) Indonesian Government is to achieve Competitiveness and Sustainability on Industry and Higher Education Institution (HEI) [1]. HEI is the main key to these initiatives. Furthermore, HEI academic course must adapt the learning process for the need not only in the theoretical area but also practice in the digital creative industries in the era Industry 4.0. [2], [3].

Project-Based Learning (PBL) offers a challenge for students to apply the knowledge and skill by creating an application to solve real-world problems [4], [5]. Also, Lab-Based Education is an educational methodology that has been implemented by the majority of universities in Japan to enhance research and publication [6].

For this matter, the use of an electronic-based portfolio (ePortfolio) in Higher Education Institution (HEI) becoming an important tool to track, evaluate, and recognize academic stakeholders (lecturers and students) achievements [7], [8]. For lecturers, ePortfolio is used as a tool for documenting an academic activity (teach and research). For students, ePortfolio also became important because it helps to store the progress that being made in the learning process [9]. Furthermore, lecturers need to evaluate the learning process and score assignments that students have submitted as a group or individually.

Our previous research, present Lecturer Based Supportive Tools (LBST) that helps lecturers create learning content online and offline conditions [10], [11]. Also, it discusses interoperability among the learning management system and distribution system with web service-oriented architecture [12]–[14]. As a completory, this paper proposed the supportive tool that supports students submit their progress report and their artifact while lecturers implement Project-Based Learning (PBL) and Lab-Based Educations (LBE).

II. Problem Analysis

A. Student Report, Grading

One advantage of the use of ePortfolio (or other support learning processes such as Learning Management Systems - LMS) is fully supported in grading that based on student's report. Aside from presenting the learning process through an online class and student's obligation to submitting their assignment, lecturers need to know how the learning process of their students. To knowing the learning process, it needs to ask several questions such as: "In what time they mostly submitted?", "Are they (students) find difficulties while submitted a system?", "Which submission that gains more attention?". Even though the existing ePortfolio and other LMS offers many features, but few of it to have features that could support the lecturer grade the student's submissions on the existing university information systems.

B. Digital Divide

The existing ePortfolio and other LMS are designated to be a centralized system. Also, the installation process itself needs more effort for a beginner user [15]. On the other side, Indonesia is a developing country that still faces the digital divide issues [16], [17]. These conditions are one of the causes that ePortfolio and LMS's are slow to spread and adapt to the learning process, especially in the higher education level [18].

C. *Research Questions*

According to previous problem analysis, the research question was: "How we provide the student with web-based ePortfolio that can be used in offline and online condition for student report, lecturers grading and export the results in existing information systems?".

III. Proposed Method

We propose to develop a web-based ePortfolio that can be accessed in online and offline conditions. The online condition means the proposed ePortfolio will be accessed in online matters. The offline condition means that the Proposed Portfolio is used in the offline condition that no need internet connectivity. By using the web-based micro-framework such as Flask and Python library called WSGI, it possible to develop web applications that adapt in both conditions [19]. To synchronize the content of both versions (Online and Offline version), we propose the current development ePortfolio in the following section.

A. *Architecture*

The proposed ePortfolio project name is YADeH (Yet Another Distributed ePortfolio for Higher Education). There are two versions of YADeH. Firstly, the YADeH server and secondly, YADeH-node. YADeH-server is a YADeH version that can be accessed online. YADeH-node is a YADeH version that designed to implemented in a mini device or used in an offline condition. The architecture of both versions was shown in Fig. 1:

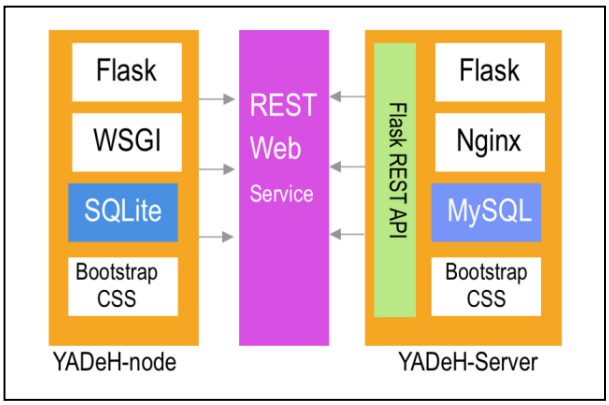


Fig. 1. Proposal for YADeH architecture.

Flask Web Framework is a python based web framework that extremely small size (version 1.0.2 size is 732 KB) [19]. Also, it already includes Werkzeug. [20]. Werkzeug is a small WSGI (Web Server Gateway Interface) that enables running Flask web application with one single command and it's running a web server [21]. This means, a user no need installs Apache/Nginx web server while installing the YADeH-node version.

For architecture development, Flask is adapting an MVC (Model-View-Controller) framework that separates the application layer and the presentation layer. This mean, the *.py file and *.html file is in a different directory. For future development, developer teams such as Front-end Developer and Back-end developer will be more convenient if the *.py file and *.html file is in a different directory.

The Flask Framework will recognize automatically all *.html files in the template folder. As the need for responsive web, the *.css, *. js file needs to store in the static folder. Fig. 2 show the separation of the presentation layer and the application layer.

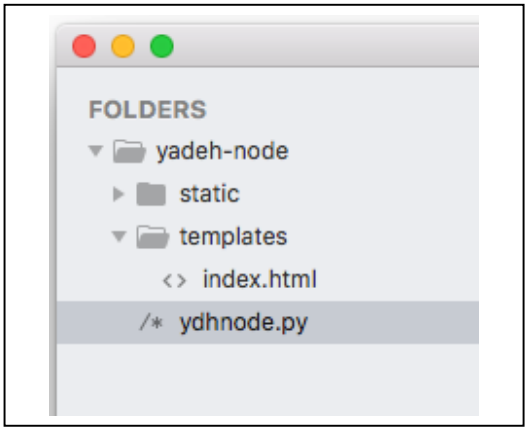


Fig. 2. Directory Structure of YADeH-node version

All request routing is controlled in *.py files. For example, we have following index.html in templates directory:

```
<!doctype html>
<html>
  <head>
    <title>YADeH Node</title>
  </head>
  <body>
    <h2>YADeH node here.</h2>
  </body>
</html>
```

Then, we have following ydhnode.py file that present the index.html if there is any request in homepage using "app.route("/"):

```
from flask import Flask, render_template
app = Flask(__name__)

app.route("/")
 def hello():
     return render_template('index.html')

if __name__ == '__main__':
    app.run()
```

To activate the Flask application and WSGI web server, the user only needs to execute a single command as same as running python. Fig. 3. shown that *.py file has executed and activated the WSGI server.

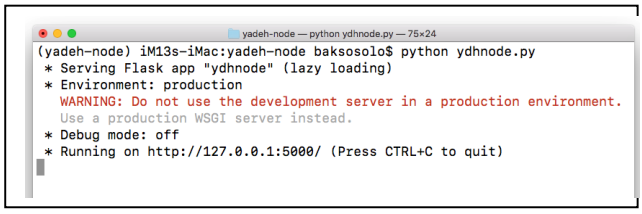


Fig. 3. WSGI activated by running *.py files.

By default, WSGI using port 5000 to serve its web requests. At local access, a user can request by accessing localhost with port 5000. The response of the Web Server shown in Fig. 4.

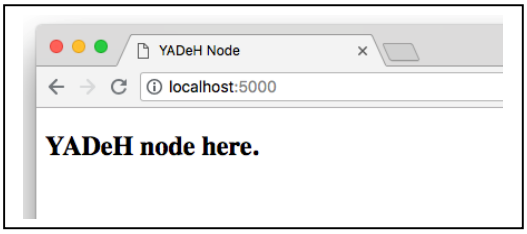


Fig. 4. Access Flask Application from a local device at port 5000.

Flask is using Jinja Templating Engine. Jinja is one of famous python template engine that developed by the same team of Flask Web Framework. Jinja has made it easier to implement Bootstrap CSS or other CSS Framework for mobile responsive. Mobile responsive CSS is enabled users accessing the HTML layout with mobile devices. With a mobile-friendly CSS framework, we no need to develop a native mobile application.

With use Flask and WSGI, we could provide a web application accessed by a user in offline conditions. To continue to support users using YADeH-node in offline condition, we implement SQLite for data storage. This means users are not necessary to install MySQL or other server-based Databases. Combining Flask, WSGI, SQLite, and Bootstrap CSS, a user can use the YADeH-node on their laptop or installed in mini devices such as APC Rock [22]. By running it in the mini device and connecting it with an access point, YadeH-node can be accessed in a classroom with conditions that there are not available internet connections.

B. *User Interactions*

The user's interactions with YADeH-node are illustrated in Fig. 5:

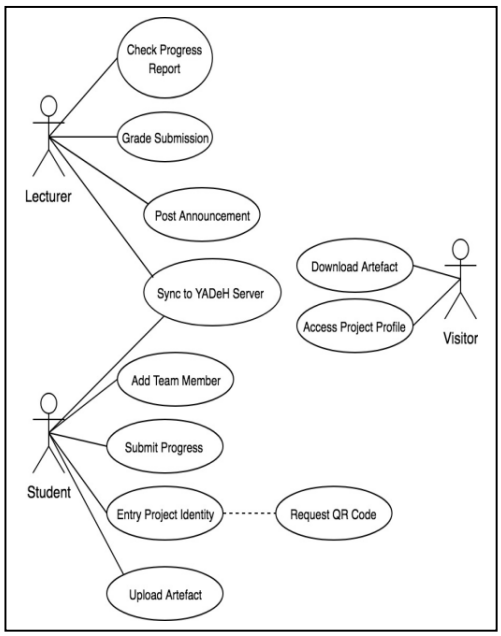


Fig. 5. User Interaction with YADeH-node.

One of the important features at YADeH-node is to upload the artifacts to YADeH-server. To able upload the saved artifacts from YADeH-node to YADeH-server, the user need to configure the YADeH-server address. These addresses are used to upload the artifacts through the YADeH-server Web service.

For web services, Flask provides Flask-restful API that can be used to manage a piece of information from the created log. First, we need to provide a resource with the following format:

```
LOCAL_LOG = {
   'title': {'value': 'Acces YS_L'},
   'evalue': {'value': '1534067324'},
   'etime': {'value': 'August 12, 2018 9:48:44'},
}
```

To expose the above resource, it needs to declare the "Resource" Class in the application and route the resource.

```
class LogList(Resource):
   def get(self):
      return LOCAL_LOG

api.add_resource(LogList, '/loglist')
```

From the above script, the statement "`api.add_resource(LogList, '/loglist')`" is used to route the request "/loglist" to "LOCAL_LOG" resources. Fig. 6, shown illustration for accessing web service.

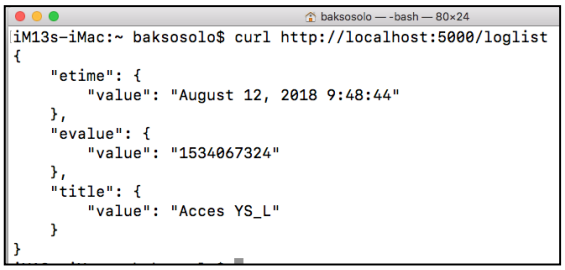


Fig. 6. Example Web Service Access

Using Flask-rest API, we can get LOCAL_LOG from YADEH-server Log (YS_LL) and YADEH-node Log (YN_LL). YS_LL and YN_LL are used for knowing which is the newest activity that users have been working on YADeH. If YS_LL value is less than YN_LL value, the content from YADeH-node is the newer version. If so, the "upload_mode" that execute uploading process will have executed. Otherwise, the "download_mode" will download the artifacts from YADeH-server. After users have selected in which version of the artifacts that are uploaded/downloaded, users need to execute the synchronization process. In early development, upload mode and download mode selection are using the EPOCH time variable. The newer version is considered with bigger value EPOCH time. These synchronization methods are illustrated in Fig. 7.

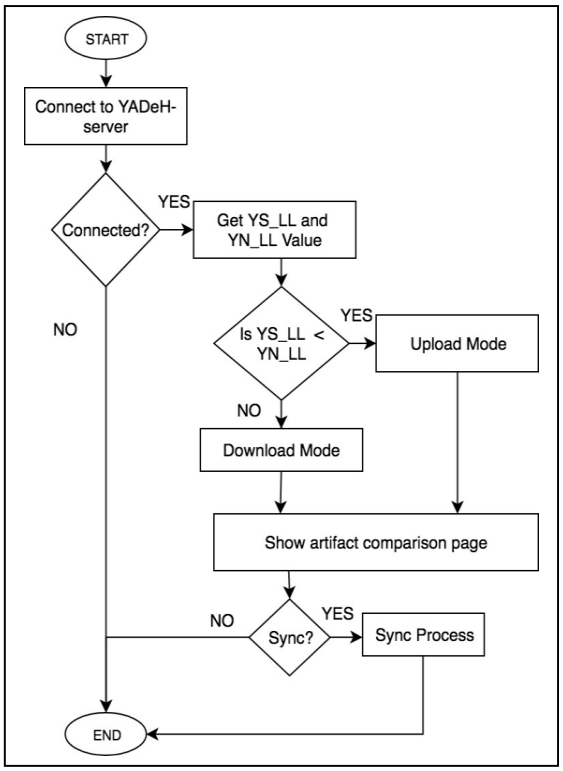


Fig. 7. Sync Process from YADeH-node to YADeH-server.

IV. Research Discussion And Implementation

In this section, we will discuss how the research conduct and present the implementation and discuss the basic features that the lecturer needs to support on current development portfolio.

A. Research Discussion

In this research, YADeH was tested to students at Informatic Departments, Faculty of Engineering, Universitas Muhammadiyah Sidoarjo at Academic Year 2017/2018. At those academic Years, the author has implemented Project Based Learning with two different groups among 6 class groups. The following table shows the Class Code and the Course Name.

TABLE I. Course Name And Class Code

Course Name	Class Code
Human Computer Interaction (HCI) (8th Semester)	HCI-8A3 HCI-8B4
Analysis and Design Information Systems (ADSI) (6th Semester)	ADSI-6A1 ADSI-6A2
Information System (IS) (4th Semester)	SI-4A3 SI-4A4

The principles of Lab Based Education (LBE) are knowledge transfer from Top level (Faculty Member) into Higher Level (Post-Doc Researcher), Mid-Level (Graduate Students) and Basic Level (4th year Undergraduate Students).

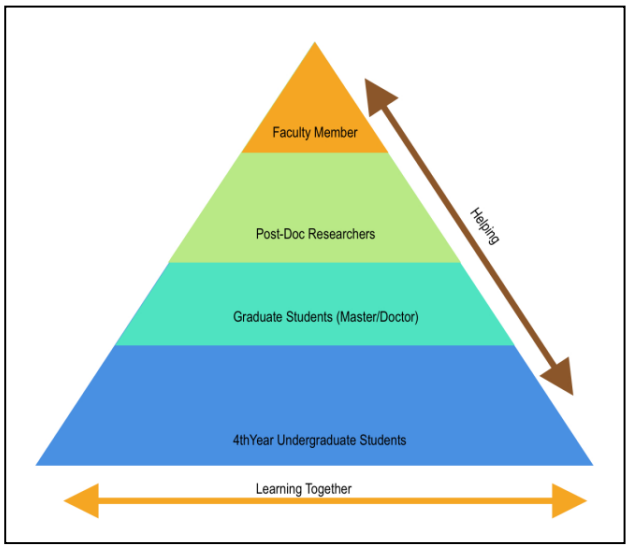


Fig. 8. Laboratory Based Education Principles

To implement Project Based Learning (PBL) and Lab Based Education (LBE), we assign all students to make an application as the Final Project. Also, set a rules that 8th semester students are responsible with UX/UI Design (as the implementation of their HCI courses), 6th semester students are responsible with diagram design (as the implementation of their ADSI courses) and 4th semester students responsible with prototype development (as the implementation of their IS courses). Also as a part of the experiments, 6 class groups are formed into 2 main groups. The group separations are illustrated in Fig. 9.

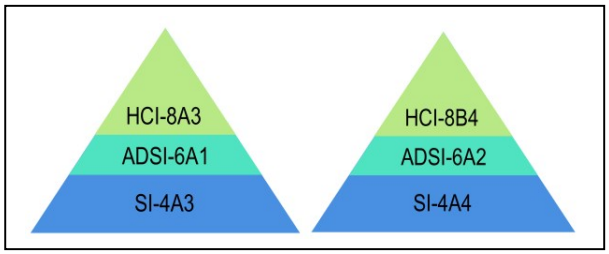


Fig. 9. Odd and Even Class Groups

B. Implementation

The first module to be developed is the user invitation module on YADeH-server. On YADeH-server, lecturers are provided with a user invitation dashboard that invites 8th semester students email. With this feature, Lecturer no needs to add all student data. This scenario also eliminates unauthorized users. Also, distribute the invitation efforts that we had experienced when using LMS on the beginning semester. It is necessary to provide a status to helps lecturers knowing the invited student has already activated the account.

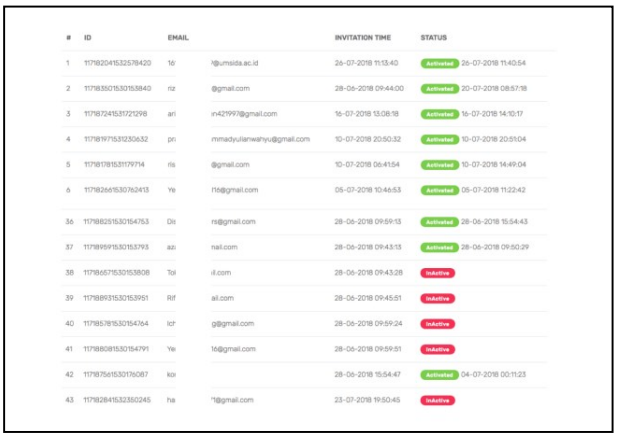


Fig. 10. Invitation dashboard of YADeH-server

Next to be developed is YADeH-node. YADeH-node is a YADeH version that mainly used by students. Firstly, Students need to provide detail information about their projects. Fig. 11 shown student dashboard to add their project description.

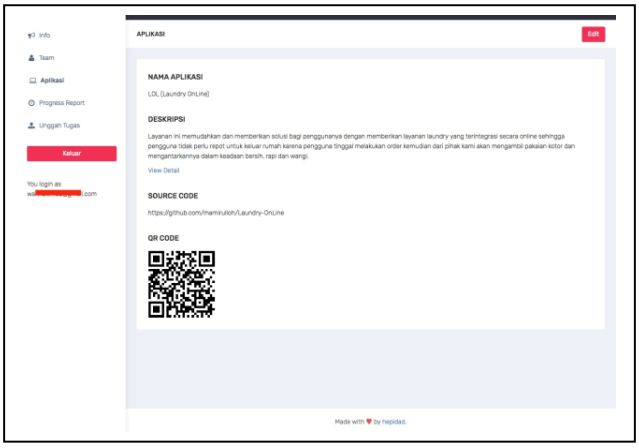


Fig. 11. User dashboard to describe their project.

As a requirement, it needs to provides a dashboard for students to submit their assignments. In this implementation, students were asked to submit their Project description, report file (PDF), Presentation files (PDF) and Poster (JPG/PNG). Fig. 12. Shown user dashboard for upload the artifacts.

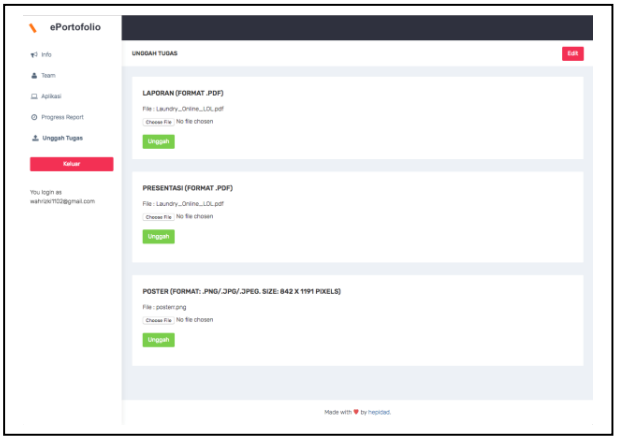


Fig. 12. User dashboard for submitting an artifact

As part of student assignment for creating a poster, student obligate download QR code that needs to paste in the created poster. The QR code represents the URL for access Project profile from each team. Also, in the user dashboard, they will have given an option to share the source code of their project or not. If they select option “Yes”, the URL of project source will show on their project profile. The front page of YADeH-server that present all students projects are shown in Fig. 13.

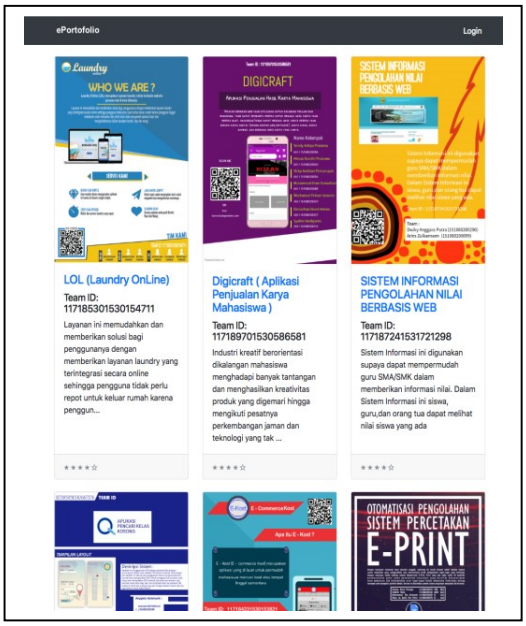


Fig. 13. The YADeH-server front page

After the student and his/her team are already submitted the artifact, lecturers are needed to grade the student artifact to all his/her team. On the YADEH-server dashboard, lecturers can grade the assignment and it will give the grading results to all team members. Lecturers no need to input the score one by one for each student. This will be helpful when each team is consisting of different students from different class groups. The lecturer dashboard for grading the assignment is shown in Fig. 14.

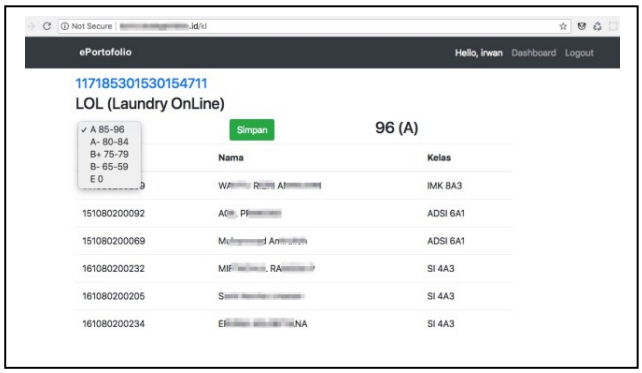
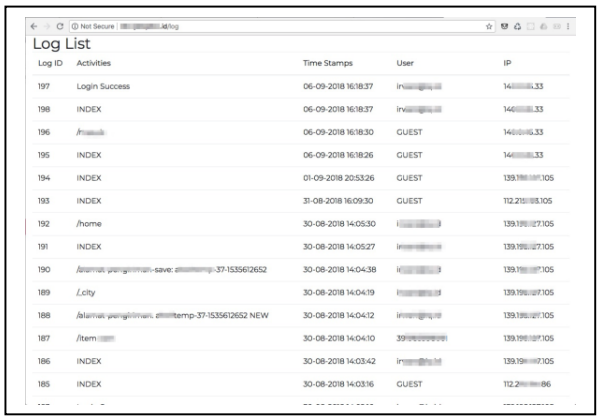


Fig. 14. Lecture dashboard for grade the assignment

To answering the research questions from section II.A., we have been implementing log creation based on user's activities and their IP address. From this log, we can query to knowing which project has more visitor, which process is "FAIL" and when they submit the artifacts. Fig. 15. shown the created log.



Log List

Log ID	Activities	Time Stamps	User	IP
197	Login Success	06-09-2018 16:18:37	ir[redacted]	14[redacted].33
198	INDEX	06-09-2018 16:18:37	ir[redacted]	140[redacted].33
196	/[redacted]	06-09-2018 16:18:30	GUEST	140[redacted]6.33
195	INDEX	06-09-2018 16:18:26	GUEST	14[redacted].33
194	INDEX	01-09-2018 20:53:26	GUEST	139.1[redacted].105
193	INDEX	31-08-2018 16:09:30	GUEST	112.21[redacted]5.105
192	/home	30-08-2018 14:05:30	[redacted]	139.1[redacted]7.105
191	INDEX	30-08-2018 14:05:27	[redacted]	139.1[redacted]7.105
190	/[redacted]-save: [redacted]-37-1535612652	30-08-2018 14:04:38	[redacted]	139.1[redacted]7.105
189	/_city	30-08-2018 14:04:19	[redacted]	139.1[redacted]7.105
188	/[redacted]temp-37-1535612652 NEW	30-08-2018 14:04:12	[redacted]	139.1[redacted]7.105
187	/item [redacted]	30-08-2018 14:04:10	39[redacted]	139.1[redacted]7.105
186	INDEX	30-08-2018 14:03:42	ir[redacted]	139.1[redacted]7.105
185	INDEX	30-08-2018 14:03:16	GUEST	112.2[redacted]86

Fig. 15. Log created by YADeH-node and YADeH-server

By providing a log, it can be used to track where students are accessing both YADeH-server and YADeH-node. Because both YADeH-server and YADeH-node are designated to record their interaction with all YADeH systems. These logs are useful for future research on learning analytics.

V. Conclusion and Future Works

A. Conclusion

YADeH-node and YADeh-server were introduced as the integration of distributed portfolios that can be used in both conditions: Online or Offline conditions. With YADeH, a student can store their submission as an artifact that can be viewed by others easily. Also, lecturers are helped with a grading system that provided by YADeH-server.

Because it has been developed with Microframework, it is possible to install it on the mini device or other hand carry device. The current development application can be used as portable ePortfolio that support student manages their learning process daily.

B. Future Works

For future works, the development of other features is needed. For example, integration with other web services from open source ePortfolio systems (such as Mahara). Or with other open-source LMS web services (Moodle, Chamilo, Canvas) to support the widespread use of ePortfolios [23]–[26].

Also, as part of future works, logs created by YADeH that determining user activities will be analyzed.

Acknowledgment

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