

Detecting Learning Style Using Hybrid Model

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Abstract— Previous research believed that identification of learning style can increase learner's motivation and understanding in the online learning process. The process of identifying learning styles can employ conventional and automatic methods. Conventional method uses questionnaires to detect learning styles. The use of questionnaires faces obstacle in which the detection results are less accurate. As to automatic method, its detection results are obtained from learner's interaction with a system. Some learners interact through Forum, Outline, Content, Exercise, and Example (FOCEE). However, automated detection of learning styles faces obstacle in which it is compared with the results of the foregoing questionnaires and Felder Silverman Learning Style Model (FSLSM) learning style, which is more as an approach to learning process. The paper proposes a VARK learning styles (Visual, Audio, Read and Kinesthetic) detection as an approach to learning materials. The model proposes a combination of literature-based detection and automatic detection, known as hybrid model. This detection model is expected to be able to detect learning styles more accurately.

Keywords— *learning styles, automatic, hybrid*

I. BACKGROUND

The definition of learning styles according to [1] is a way of learning that learners do to improve concentration in learning, through learner's behavior such as: reading, seeing, hearing and imitating. Learning styles is expected to help improve learner's motivation and understanding of the learning materials. Research conducted by Felder explained that the identification of learning styles will help learners to concentrate in understanding the learning materials [1]. The process of identifying learning style is usually conducted using conventional and automatic methods.

Questionnaires are used in the conventional learning style identification process. The obstacle of this approach is accuracy because learners will feel bored and most of them do not take the questionnaires seriously. This influences identification result, of which the scores do not completely indicate the learners' learning styles when compared to the reality.

The second opinion detects learning styles using automatic approach. This approach is also divided into two methods, namely data-driven and literature-based methods [2]. Both methods result in learning style that is based on the data regarding learners' interaction behavior with a system, such as by attending the Forum, Outline, Content, Exercise, and Example (FOCEE). Literature-based detection of learning style is conducted based on learners' interaction with a system. The result of FOCEE interaction is obtained by calculating learners' visit and stay time on learning materials. The results of this interaction will show how long a learner stays in a specified learning material and how long his/her real stay is. Similar calculation is conducted to the visit time on learning material: what learning materials are visited and how long the visit takes. After data is collected, it can be manually classified into several learning styles.

Meanwhile, data-driven method uses one of the artificial intelligent methods such as: Bayesian, nbtrec classification and Decision Tree. Bayesian method uses probability technique of the learner's learning styles obtained from the data-driven results retrieved from the system. Results of this detection are approximately 60%-80% accurate. The same procedure is conducted with nbtrec classification and decision tree methods.

Both automatic detection results are usually compared with questionnaires results. Therein lies the weakness of the former detection results. This paper will combine literature-based and automatic methods into hybrid model to obtain accurate detection of learning styles. This paper also proposes a detection process of learning style using Learning Management System which faces obstacle in adaptive learning.

II. DETECTION MODELS OF LEARNING STYLES

Several detection models of learning styles have been studied previously. Several previous studies were conducted using Learning Management System (LMS) [3].

Detection approach of learning style using LMS has been done by Graf [4], Abdullah [5], Imran [6], Dung [2] and Pitigala [7]. They detected learning styles using conventional and automatic approach. Table 1 below will provide comparative information of learning style detection from prior researches.

Tabel 1 Comparison of learning styles detection

Researcher	LMS	Learning Style	Approach
Graf	Moodle	FSLSM	Literature-based
Abdullah	Moodle	FSLSM	Conventional and Literature-Based
Imran	Moodle	FSLSM	Literature-based
Dung	POLCA	FSLSM	Literature-based
Pitigala	Moodle	FSLSM	Literature-based
Gracia	-	FSLSM	Data Driven

Graf's Research detected FSLSM learning styles using literature-based approach [4]. Graf used Moodle learning management system to discover each student's learning style. Approximately 70% - 80% of the detection results were very helpful for the learners to identify their learning styles.

A research to detect other learning styles was also conducted by Abdullah using Moodle LMS as well, but he used the conventional approach which is questionnaire- and literature-based [5]. The approach was then adjusted to FSLSM learning style. The result of the detection was approximately 50% -80%.

Imran's research detected FSLSM learning styles using literature-based approach and Moodle in its implementation [6]. He used equations of learners accessing learning materials. There were ten equations used as the reference, namely comment, content, Reflection quizzes, Additional learning materials, example, self-assessment tests, Discussion Forum, Animation, Real Life Application, Exercises, and Conclusion. The results Imran's detection of learning styles Imran were precision value of 60% -80%.

Dung's research detected learning style by establishing a Learning Management System (LMS) named POLCA [8] [2]. POLCA was used to detect Felder Silverman Learning Style Model (FSLSM) learning style. The process to discover learner's learning style was begun by filling out questionnaires on Index of Learning Style (ILS), which determine the learning styles and provide learning materials. The results of Dung learning styles detection were approximately 65% -85%.

Pitigala's Research adopted Moodle learning management system to establish a new system, named PLORS [7]. PLORS was able to detect FSLSM learning styles by establishing learning style monitoring and learning agent profile creation (LLA) designed for Moodle. The process of learning style monitoring used questionnaires and LLA by examining the learners' interaction with the system. FSLSM learning styles detection results generated 63% -78%.

Bayesian Networks research [9] used data from the students log that, forums and processing. Based on the log data, Bayesian networks provided two independent note tables, one is a table based on the analysis of log data and another is a table of dependent conditional Probability. There were three Felder Silverman learning styles detected, namely Perception, Processing and Understanding [9].

Agent learning

There are two situations occurred in the agent, namely perception of the environment and which finally resulted in the action towards the environment [10]. Perception is obtained from various sensors, which in this system perception is obtained from learners' interaction with the system. Results of sensors detection will be processed, which will then generate action. Action

originating from learners' sensor interaction with the system generates action towards learning materials in accordance with learning style that have been detected.

III. RESEARCH OPPORTUNITY

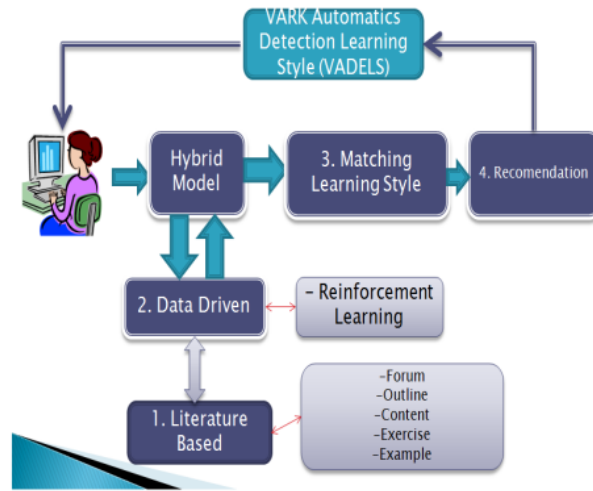


Figure 1. Detection architecture of learning style

Figure 1 above shows that learning styles are automatically detected into two parts, namely literature-based and data-driven detection.

The first step in using literature-based detection employs calculations of the time spent by the learners in visiting learning materials. The calculating process compares the specified length of time with the length of real time visit. The one calculated is learners' visits to FOCEE, therefore learners' learning styles are generated.

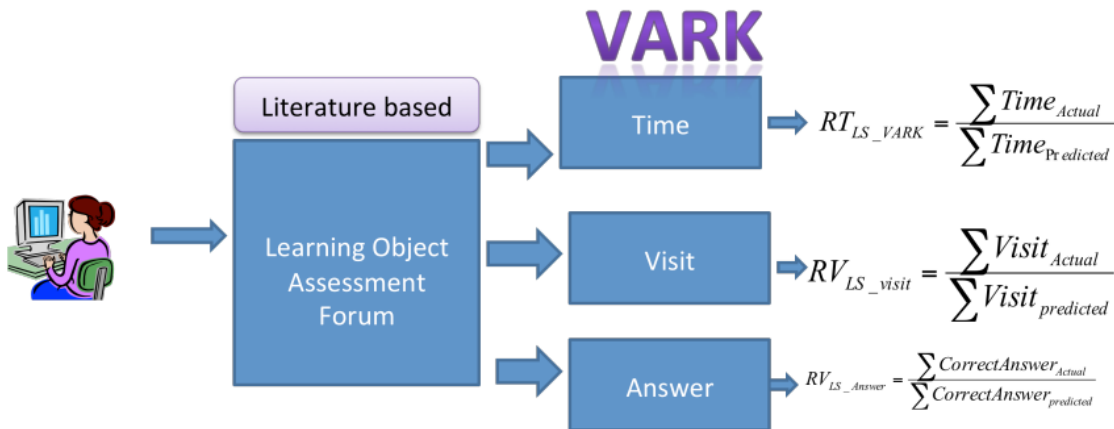


Figure 2. Literature-based Detection

Figure 3 is a picture of data-driven detection of learning styles. The system will read learners' interaction with learning materials which are presented in visual, audio, reading and kinesthetic forms. During their interactions with those learning materials, the system will calculate and read log data of interactions and visits towards content and outline. The same process is done by the system to calculate the learner's time spent in visiting the outline and the content. Visit time is a predefined duration, and when learners pay their visit, time difference from the predefined time is generated. In the final stage, the system will assess the learners' answers to the questions located on the example and exercise sections. These three processes above are carried out to generate learning styles. Learning styles that have been identified through the identification mechanism will generate recommendation.

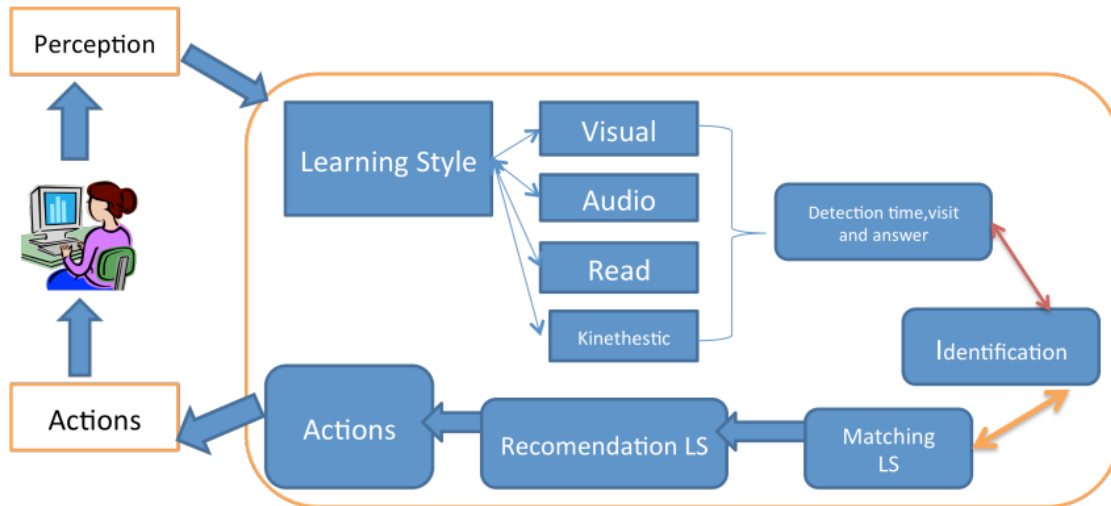


Figure 3. Data-driven detection

Figure 3 is the second step of using a data-driven detection by processing data from the learners' interaction with the system. As for their interaction with forum, outline, content, example and exercise (FOCEE), it will be processed using agent learning.

Both steps, **data-driven and literature-based** detection methods, are **called hybrid** model of learning styles. The result of this detection provides a recommendation for the learners to use learning materials that are in accordance with the learning style that has been detected.

IV. CONCLUSION

In this paper, we described a hybrid model using literature-based approach and data-driven approach. We also defined general rules and suggested an algorithm with the purpose of identifying learners' learning styles automatically and dynamically based on learners' behaviors.

For our future work, we are planning to enhance the proposed dynamic technique by following two main steps. First, we will expand the features and behavior patterns by adding more components of the system, i.e., forum, outlines, content, exercise and example. Second, we will use agent learning to detect learning style based on perception and action.

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