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العدد 19

مجلة التربوي

مجلة علمية محكمة تصدر عن كلية التربية

جامعة المرقب

العدد التاسع عشر

يوليو 2021م

- **المجلة ترحب بما يرد عليها من أبحاث وعلى استعداد لنشرها بعد التحكيم .**
- **المجلة تحترم كل الاحترام آراء المحكمين وتعمل بمقتضاها .**
- **كافة الآراء والأفكار المنشورة تعبر عن آراء أصحابها ولا تتحمل المجلة تبعاتها .**
- **يتحمل الباحث مسؤولية الأمانة العلمية وهو المسؤول عما ينشر له .**
- **البحوث المقدمة للنشر لا ترد لأصحابها نشرت أو لم تنشر .**

ضوابط النشر:

يشترط في البحوث العلمية المقدمة للنشر أن يراعى فيها ما يأتي :

- أصول البحث العلمي وقواعده .
- ألا تكون المادة العلمية قد سبق نشرها أو كانت جزءا من رسالة علمية .
- يرفق بالبحث تزكية لغوية وفق أنموذج معد .
- تعدل البحوث المقبولة وتصحح وفق ما يراه المحكمون .
- التزام الباحث بالضوابط التي وضعتها المجلة من عدد الصفحات ، ونوع الخط ورقمه ، والفترات الزمنية الممنوحة للتعديل ، وما يستجد من ضوابط تضعها المجلة مستقبلا .

تنبيهات :

- للمجلة الحق في تعديل البحث أو طلب تعديله أو رفضه .
- يخضع البحث في النشر لأولويات المجلة وسياستها .
- البحوث المنشورة تعبر عن وجهة نظر أصحابها ، ولا تعبر عن وجهة نظر المجلة .

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THEORETICAL RESEARCH ON AI TECHNOLOGIES FOR LEARNING SYSEM

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Abstract. The traditional learning systems have many challenges of manage the learning aspects (students, teachers, and materials) efficiently due to dynamic changes of learning environments. The researchers adapt various AI approaches such as NN, FL, and SVM approaches to control the learning environment dynamicity and manage the learning aspects efficiently in order to maximize the learning outcomes performances. This paper will review many AI researches to maximize the learning outcomes in three main areas; sign languages detecting and translating, learning disability, and computer aided learning. The main aim of this paper is to review how the AI approaches can be adapted to avoid different challenges in learning areas. The comparisons between the reviewed researches will explain the advantages and disadvantages of AI approaches.

Keywords: *learning environment, sign languages, learning disability, computer aided learning, neural network, fuzzy logic, and space vector machine.*

1 Introduction

There are many challenges face the traditional management of learning environment due to complexity and dynamicity of learning aspects behaviors and characteristics [4] [11]. For example, the students learning skills are different. Thus, the learning materials could be match with the student level. However, the traditional learning systems share the same material for all students. On the other hand, there are many students have learning disabilities which maximize the difficulty of the learning processes; there are many types of learning disabilities [3] [5]. Therefore, it is necessary to determine the students' types and characteristics in order to adapt the most suitable learning styles. Moreover, the deaf persons have not enough skills to represent their needs through writing style, and they face difficulty to read the traditional texts. Thus, the sign languages developed to simplify the communication between deaf and normal people [10] [12]. However, the normal people have difficulty to understand the sign languages.

The researchers work on develop learning systems using AI approaches to provide the management of dynamicity factor. AI approaches considered as useful and accurate approach to manage the learning environments adaptively and cover the changes and updates of learning aspects. The main aim of apply AI approaches in learning systems is to provide more accurate outcomes of learning processes. For examples, the AI systems process and classify the learning contents and students profiles to provide the most accurate materials

for each student electronically. Also, the AI systems can analyze the behaviors and characteristics of learning disabilities students to analyze the disability type of each student and determine the most efficient learning activities and styles for them. On the other side, the AI systems can detect the sign language representations such as figure and hand gestures and analyze the meaning of these signs before translate it to texts in various language's. Thus the deaf and normal person can contact with each other easily at real time.

2 Related Works

2.1 Signs Language

Su et.al [13] developed a system to analyze the movement of fingers or the sign language based on figures representations to traditional English language. The complexity of analyze accurate translation of fingers gestures is the main challenge of the developed system. The researchers apply the Neural Network (NN) approach to classify the possible representations of deaf figures supporting by supervised decision-directed learning (SDDL) algorithm to execute the suitable rules using simple if-then based on the inputs classifications of neural network. The methodology of Su et.al [13] as the following:

1. Classify the figures gestures (single figure, two figures, three or more figures).
2. Detect the classification type use sensors of EMI-Gloveswhich used by deaf person.
3. Detect each used figure gesture.
4. Apply SDDL algorithm to analyze the possible meaning of gestures combinations.
5. Display the highest accurate possibilities.

Su et.al [13] tests their system on 4 deaf persons based on Taiwan sign language through 51 different fingers gestures; each deaf person repeat the gestures many times to ensure the execution accuracy. Some examples record 100% as accurate results; the average of results accuracy of Su et.al [13] system records 93.9%.
One the other hand, Li [6] focuses on the same area of Su et.al [13]; Li [6] works on the hands gestures of deaf persons rather than fingers gestures. However, analysis of hand gestures representations is more complex due to free and large movements of deaf hands. The researcher adapt the Fuzzy C-Means (FCM) approach to classify the hands gestures as many clusters and each cluster contain the hand gestures that support specific purpose. The researcher use the light camera to detect the hand gestures; lift and right gestures for x-ray and z-ray, forward and backward gestures to repeat or insert the gestures, stop to finish the processes, and home to repeat the whole process Figure 1 illustrates the gestures directions.

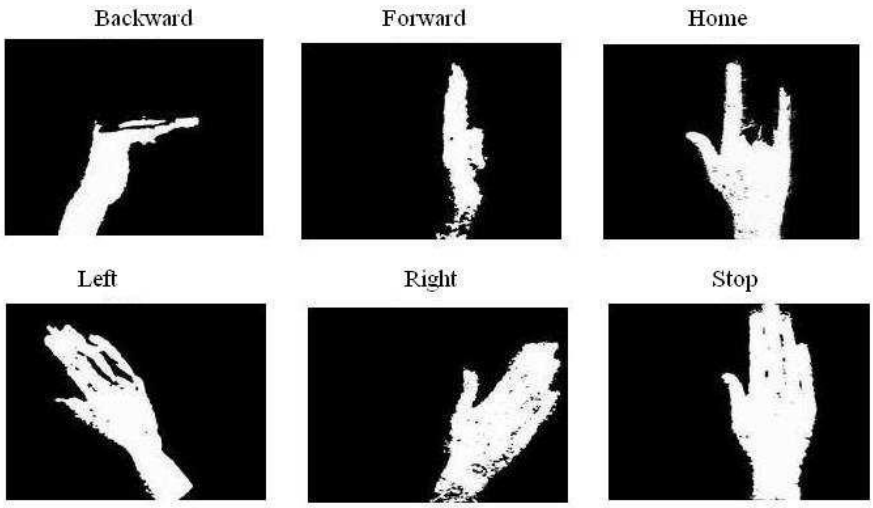

Fig. 1. Processes of gestures detecting

The following steps represent the main methodology of Li [6]:

1. Classify the main clusters of hand gestures depend on the sex-gestures types that illustrates in figure 1.
2. Detect the gestures using light camera.
3. Analyze to which gesture type that the input belong to.

FCM applied to analyze the angles and curves of the hand gestures that detected using the light camera and determine the most accurate center of these angles and curves; the analysis process determine the most suitable cluster of the inputs. The main aim of this research is to help the deaf persons to execute digital processes in their daily activities such walking across streets. Li [6] apply 20 different samples of hand gestures to test his proposed approach; the average of accuracy results is 85.83%.

Mapari and Kharat [8] adapt the Space Vector Machine (SVM) to divide the American Sign Language (ASL) images into many parts as two main vectors; (1) Peaks, and (2) Valleys. On the side, the researcher applies neural network approach to classify the peaks and valleys based on its angles as English letters (A, B, C…). The main aim of this research is to detect the sign language images and convert it to digital information which supports the translation from ASL to traditional texts. Figure 2 illustrates the methodology of Mapari and Kharat [8]. The accuracy result of their research is 100%.

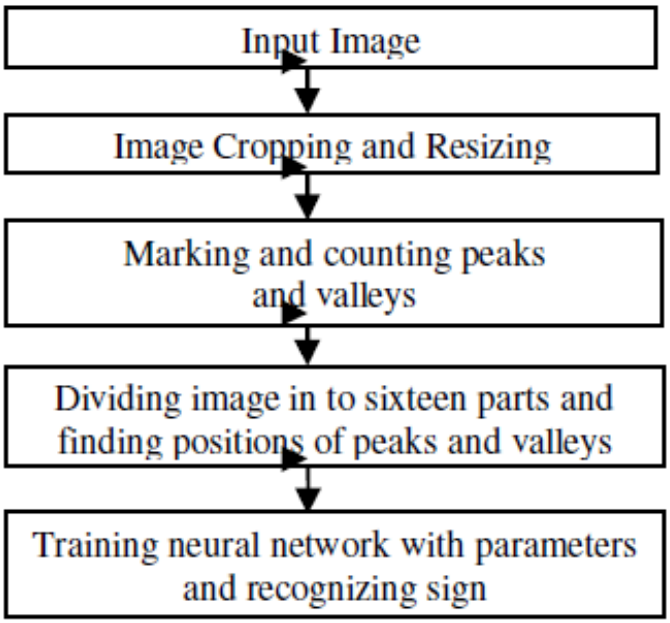

Fig. 2. Mapari and Kharat [8] Methodology

2.2 Learning Disability

Manghirmalani et al. [7] mentioned that the people who have learning disability need special care from their society. Thus, the special learning community researches grow up in the last 10 years. Manghirmalani et al. [7] the researchers apply the artificial intelligent approaches to avoid the difficulty of determine the reasons of learning disability accurately. Manghirmalani et al. [7] adapt the Fuzzy Logic (FL) approach to classify the cases of learning disability into three main clusters; (1) dyslexia, (2) dysgraphia, or (3) dyscalculia. Figure 3 presents the block diagram of Manghirmalani et al. [7]. The researchers handle the cases of learning disability before detect the properties of the inputs based on fuzzy rules; the results of rules aggregated to determine what the best classification of the inputs. Finally, the cases classified as one from three types (dyslexia, dysgraphia, or dyscalculia).

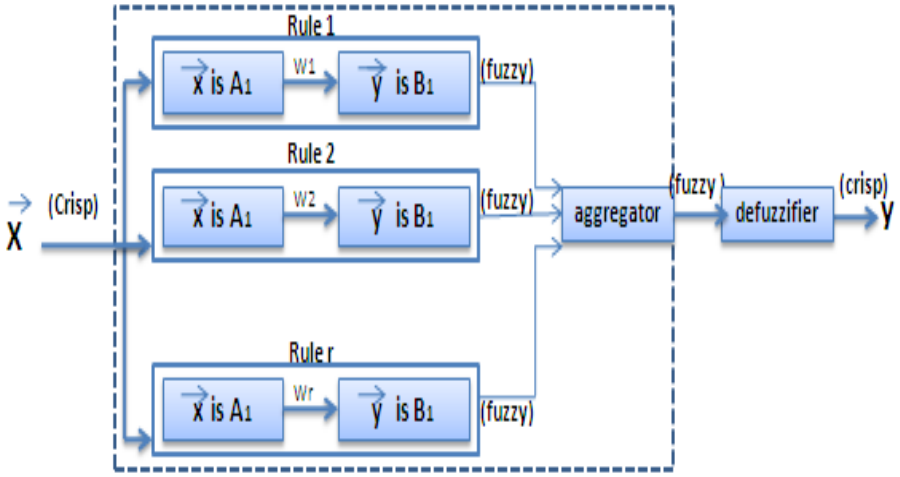

Fig. 3. Block diagram of Manghirmalani et al. [7].

The proposed method of Manghirmalani et al. [7] applied on 10, 20, 30… and 70 students of different cases of learning disability; the researcher mentioned that when the experimental sample increases the accuracy of the results also increase. For example the training set of 70 students' record 90% as accuracy results comparing with 50% for the training set of 10 students.

On the other hand, Wu et al. [15] mentioned that the learning disabilities types are determined based on complex properties of students. However, the analyzing of learning disabilities types is important to adapt the most suitable special learning styles. According Wu et al. [15], the large and historical data of learning disabilities cases maximize the accuracy performance of machines learning. Thus, the researchers adapt the neural network approach due to its ability to collect, processes, and classify the large data from various resources. The following steps represent the main methodology of Wu et al. [15] research:

1. Track the students' properties for three years (2002, 2003, and 2004). The training set was selected from Taoyuan County in Taiwan.
2. Apply the neural network to classify the student properties based on their learning power that required completing three sequence stages (1st stage, 2nd stage, and 3rd stage).
3. The neural network collects the learning data from the same students each fixed duration. Thus, the students' classifications are changed continually.
4. The rules of learning disability determining applied on the students cases.
5. Analyze the learning disabilities type of each case.

According to Wu et al. [15] results, they provide that the neural network (90%) more accurate than other approach such as K-Nearest Neighbors (75%), and Classification Tree (85%).

ÇELİK et al. [2] developed Educational Activities Finder (EAF) to satisfy the children's need of learning activities based on their characteristics such as age, gender, and learning powers. ÇELİK et al. [2] apply the adaptive semantic search approach to achieve the main objective of their research which is to track the children's characteristics and retrieve the most suitable learning activities for them. However, the traditional search engines are static based systems. ÇELİK et al. [2] mentioned that the machine learning is important to apply the same rules on any new cases. Thus, the profiles of children activities created to match between the children's activities and the most efficient activities for the same cases.Actually, the Space Vector Machine is the method that adapted in ÇELİK et al. [2] research to classify the children's activities types into three main classifications; (1) house activities, (2) school activities, (3) special learning activities. Figure 4 illustratesthe research block diagram of ÇELİK et al. [2]; the researchers considered that each activities is vector, if the results of matching between the activities clusters or ontology and the child characteristics compatible with this vector then it will be retrieved. In the other words, the query of needs will compare with the child's profiles before retrieve the most suitable vectors or activities.

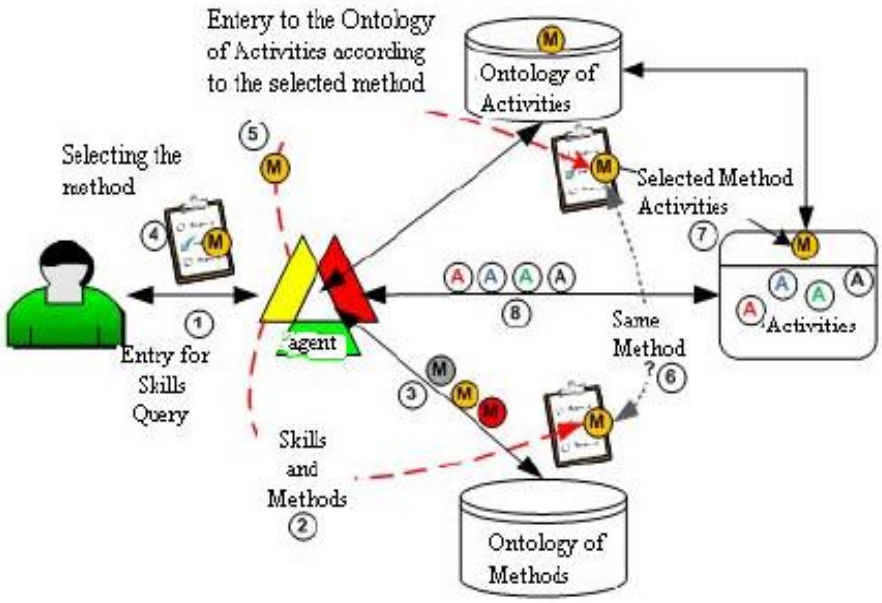

Fig. 4. Block diagram of ÇELİK et al. [2].

ÇELİK et al. [2] mentioned that according to real tests, the proposed method is more acceptable than the traditional search engines.

2.3 Computer Aided Learning

Al-Aubidy [1] mentioned that one from the main challenges of traditional learning systems is the difficulty of analyzes the students' skills and knowledge to deliver the suitable learning contents that matches with students' levels. However, the traditional learning systems share the same learning contents with all students of different learning levels. Al-Aubidy [1] apply the Fuzzy Logic (FL) approach as decision making system in order to classify the students based on their skills and knowledge levels and share the suitable learning material for them. Figure 5 illustrates the system design of Al-Aubidy [1]; the researchers create profiles for each student to store the assessments record that represent the students' levels (very good, good, and poor). On the other side, the teaching materials that deal with all learners levels stored in separate repository (A, B, and C). The FL plays the decision making role to match between the classifications of learners' levels and materials levels. The FL processes contain additional complex rules such as recommend the previous and future material for each students based on their current statuses.The experimental results of Al-Aubidy [1] show that developed system is useful.

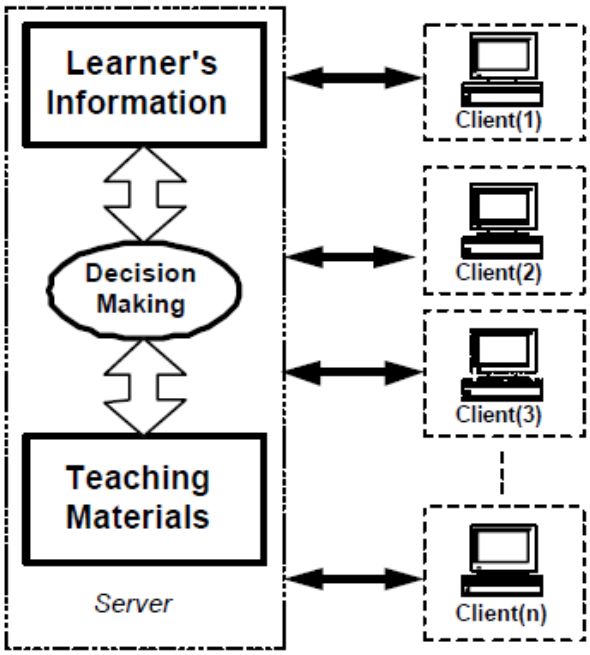

Fig. 5. System Design of Al-Aubidy [1]

On the other hand, Wang et al. [14] developed online training systems of English language to support the English learners based on their experiences and skills. The researchers apply the Neural Network (NN) approach to classify the training materials into many classes and share the most suitable contents based on the executed rules that measure the learners'

characteristics. The difficulty of Wang et al. [14] work is how to collect parts or pieces of information and aggregate it to represent efficient materials for learners based on their situations. Figure 6 illustrates the model construction of Wang et al. [14]; (1) the inputs layer collect and prepare the learners data that measure their needs, (2) the hidden layer start to found the match between inputs and repository of learning materials, and (3) the output layer display the aggregated matches as one learning materials. The results of Wang et al. [14] research show that the developed system is useful and easy to use.

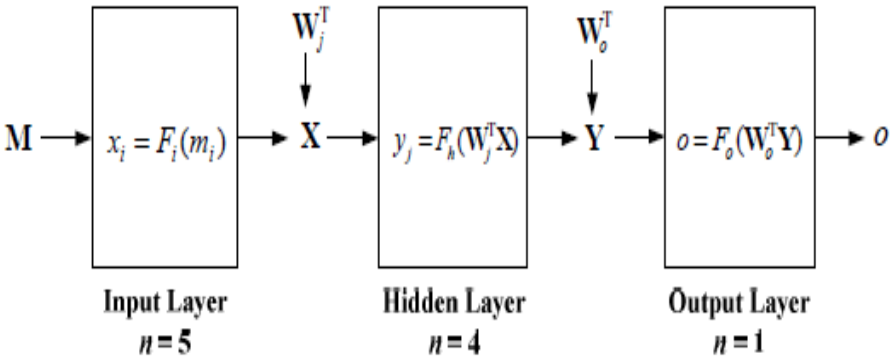

Fig. 6. Wang et al. [14] Construction Model

Goodarzi and Rafe [9] focus on the same problem and objective of Al-Aubidy [1]. Goodarzi and Rafe [9] developed expert online system using fuzzy expert approach to support the students' learning activities without need of real teachers. Figure 7 illustrates the framework of Goodarzi and Rafe [9] research; there are many variables measure the students' levels (poor-excellent) when the students search about learning material in specific topic, the system will collect the most efficient materials and store it in internal repository for the future processes. The collected materials will measures through many if-then statements to detect which is the most efficient information for the students. The expert system will store and update all new records of students and materials profiles to use it directly in the next time without need to collect new materials. The results of Goodarzi and Rafe [9] research show that the developed system is useful.

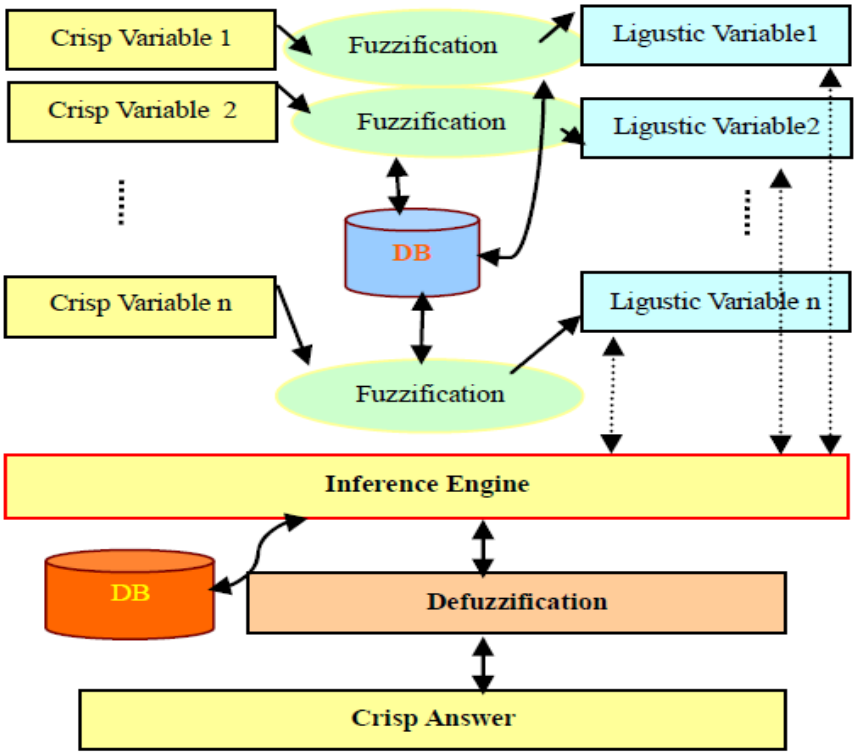

Fig. 7. Framework of Goodarzi and Rafe [9]

3 Conclusion

According to reviewed researches, the fuzzy logic, neural network, and space vector machine are the main AI approaches that applied on learning systems due to many reasons which are:

1. The learning environments are complex by default. Therefore, the classification approaches is the most suitable method to manage the various learning aspects characteristics.
2. The learning environments contain large volume of data and information; the clustering and classifying methods are necessary to group these data based on related variables.

3. There are complex interrelations between classifications of learning materials and other learning aspects classification i.e. students. Thus, the rules statements need to be applied through AI approaches; the neural network and fuzzy approaches are the most efficient approaches that apply the rules statements.

However, there are many advantages and disadvantages of neural network, vector space and fuzzy approaches; Table 1 presents comparison between the three approaches.

Table 1. Comparison between AI Approaches.

Properties	Neural Network	Fuzzy Systems	Space Vector Machine
Working with Large volume of Data	Excellent	Excellent	Very Good
Working with historical data	Excellent	Good	Poor
Classifications and Clustering	Excellent	Very good	Excellent
Analyze complex rules	Excellent	Excellent	Excellent
provide accurate results at Real Time	Excellent	Very good	Poor
Execute additional process such as information measurements	Poor	Excellent	Poor
Architecture Complexity	Moderate	Complex	Easy
Supporting approaches	No need	Needed to maximize the accuracy	Needed

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