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Utilization of Fuzzy Ontology for the Meaning of Homonymous and Homophones Ambiguous Sentences

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Abstract
The ambiguous sentences Homonyms and Homophones become a big problem when processed by computers. From these problems, a Novelty was found; the Novelty created a system that was able to recognize ambiguous sentences of Homonyms and Homophones. The process that the system runs for the first time is to test the proximity of the ambiguous sentences entered with the data set; from this process, the ambiguous sentences entered can already be recognized as the meaning of the sentence. The resulting result is how many per cent the level of similarity. Then the results are processed with the fuzzy ontology method. The results of the Fuzzy Ontology are low similarity level, moderate similarity level, and high similarity level. The method used to analyze this research is the confusion matrix, the precision results obtained were 92%, recall was 100%, and accuracy was 96%. In the future, this research can be used to refine translation results in a translation system.

Keywords: Confusion Matrix, Fuzzy Ontology, Homophone, Homonymous, Similarity

1. Introduction

The Pandemic COVID-19 disasters had significantly hit various human sectors, such as health, psychological, and education sectors (Prakmukti, et al., 2020; Pramukti, et al., 2022; Prakoeswa, et al., 2021; Munir and Pandin, 2022). Today the impact of Post COVID-19 is exacerbated by the many disasters that have occurred, thus adding to the situation on the community, especially the learning process on students (Isnaini, et al., 2022; Pandin, et al., 2021; Waloejo, et al., 2022; Ketut, et al., 2019). The unexpected impact of pandemic COVID-19 situation, especially in the field of education, encouraging the use of digital technology has massive impact on students learning process Rahim, et al., 2019; Batiari, et al., 2022. The potential performance of the language translation system can be help during this condition.

Ambiguous sentences are sentences that have multiple meanings. There are three types of ambiguous sentences, namely homophones, homonyms, and homographs (Fakih, 2022; Peters, 1979; Husain & Asghar, 2017; Cronk, 2001). This study discusses Homonym and ambiguous homophone sentences. Homonym-ambiguous sentences are ambiguous sentences that have the same pronunciation and spelling while the meaning is the same. Homophone ambiguous sentences have the same pronunciation but different spelling and meaning (Ramadhani, et al., 2020; Kamowski-Shakibai & Cairns, 2020).

Homonymous and homophone-ambiguous sentences are not a big deal when processed and used to communicate with other human beings, but sometimes it takes a little longer to understand homonymous and Homophone ambiguous sentences (Dalrymple-Alford, 1984; Eviatar, et al., 2023; Bustamin, et al., 2016). When a computer processes ambiguous sentences, there will inevitably be errors in meaning because the computer cannot understand the words that form an ambiguous sentence, Homonym and Homophone.

Currently, there is no research on the introduction of ambiguous sentences with homonyms and homophones. Currently, existing research only discusses word similarity and translation systems. There is no research that specifically discusses the meaning of ambiguous sentences with homonyms and homophones (Khisamova, 2020).

Based on the discussion above, a Novelty was found. Novelty is creating a system of interpreting ambiguous sentences with homonyms and homophones. To realize this Novelty, this research creates a system of interpreting Homonym and ambiguous homophone sentences with fuzzy ontology.

The system-built works by testing the Similarity between the test data (Homonym ambiguous sentences/ Homophones) and the data set (Homonym ambiguous sentences/ Homophones) (Khisamova, 2020; Fasko, 2016). The meaning of the sentence being tested is determined from the highest level of Similarity; the level of Similarity is displayed in the form of a percentage. A percentage form is a crunch number which is difficult to understand. Fuzzy Ontology is used to change the crunch number. Fuzzy Ontology converts crips numbers into Categorical numbers. The categorical numbers are low, medium, and high Similarity (El-Sappagh, 2015; Zhai, et al., 2008; Abou-of, 2020).

An analysis needed to determine the success rate of this system, to determine the success rate of this system, Confusion Matric is needed (Gokul, et al., 2017). With the Confusion Matric, the level of accuracy, precision, and recall can be known. After being analyzed, the meaning of ambiguous homonym sentences has a precision value of 92%, recall of 100%, and accuracy of 96%. while, the ambiguous meaning of Homophones has a precision value of 96%, recall of 96%, and accuracy of 96%. Meanwhile, judging from the almost equal amount of precision, recall, and accuracy, the meaning of ambiguous sentences of Homophones and Homonyms can be said to be successful.

From these results, it can be concluded that the Fuzzy Ontology method can be used to analyze Homonym ambiguous sentences and Homophone ambiguous sentences. This research can later be used to improve the performance of the language translation system.

2. Material and Method

Homonym and Homophone ambiguous sentence meaning system utilizes similarity to determine the level of similarity of the test data with the data set. The results of the similarity are then converted into categorical numbers using Fuzzy Ontology (Zhai, et al., 2008; Lv, 2010). The following is a simple description of the system.

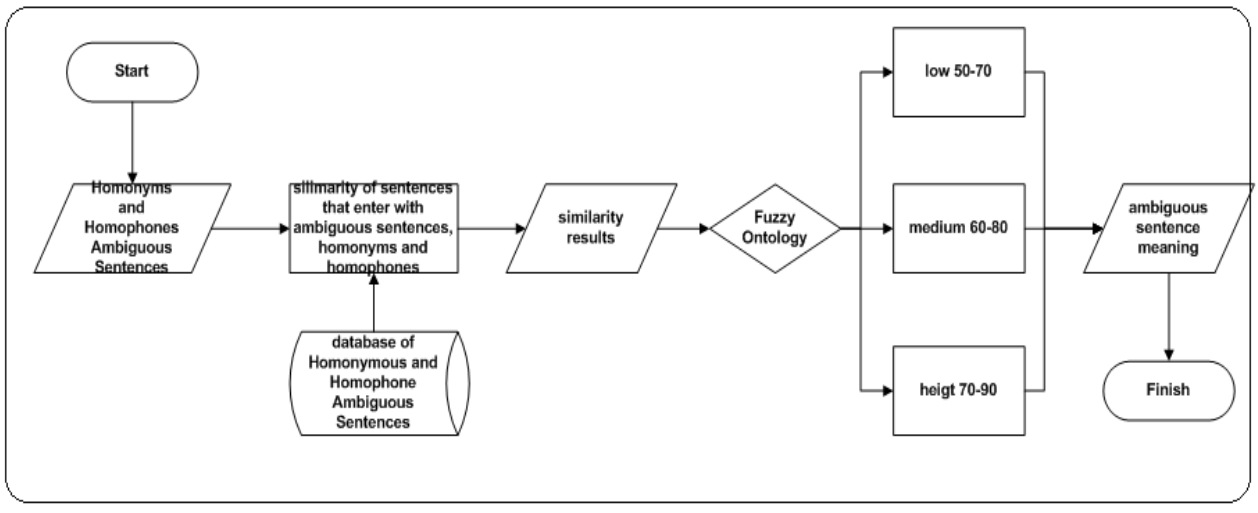

Figure 1. Flowchart of the meaning of ambiguous sentences of homonyms and homophones

Input ambiguous sentences Homonyms and Homophones

Sentences that are inputted are homonym and homophone ambiguous sentences, homonym ambiguous sentences are ambiguous sentences that have the same pronunciation and spelling, while the meaning is the same. Homophone ambiguous sentences have the same pronunciation, but different spelling and meaning (Peleg, et al., 2016; Wang, et al., 2023; Taladngoe & Esteban, 2022; Kadem, et

al., 2020). The following are examples of ambiguous sentences that are inputted Homonyms and Homophones.

Table 1. Ambiguous Sentences Homonyms and Homophone

ID	Homonym/ Homophones ambiguous sentences	Ambiguous Kind
1	I bought a water hose to water the plants (*Aku membeli selang air untuk menyiram tanaman*)	Homonim
2	I'm saving tomorrow at the East Java bank. (*Aku besok menabung di bank Jatim)*	Homophone

The sentence in table 1 may have a double meaning because the sentence is included in the ambiguous sentence Homophones and Homonyms. In order for the sentence to be understood the meaning of the sentence must be tested for its similarity with similarity_PHP.

Similarity

After inputting ambiguous sentences of Homonyms and Homophones, the sentences are then tested for similarity with the data set of ambiguous sentences of Homonyms and Homophones (Cronk, 2001; Ochs, 2011; Zhou & Zhang, 2008). The following is a data set of Homonym and Homophone ambiguous sentences.

Table 2. Homonym and Homophone Ambiguous Sentence Data Set

Id	Homonym/Homophone ambiguous sentence	Ambiguous word	Ambiguous Kind	Meaning
1	*aku membeli selang air di toko* (I bought a water hose at the shop)	Selang (hose)	homonym	A device for dispensing water
2	*Selang satu jam dia langsung melahirkan* (Within an hour she immediately gave birth)	Selang (interval)	homonym	Pause
3	*Saya menabungkan gaji di bank* (I place my salary in a Bank)	Bank (Bank)	Homophones	Place to save money
4	*Bang tolong ambilkan bukuku di meja* (Brother please get my book in the desk.	Bang (Brother)	Homof Homophones	Brother

The entered sentences are then matched with the data set, the method used to match is similiarity_PHP. The result of interpreting ambiguous sentences with similarity_PHP is the percentage of similarity between ambiguous sentences and the data set. The meaning of the entered sentences is taken from the percentage of similarity of the test data with the data set of ambiguous sentences Homonyms and Homophones. The following is the result of the similarity of the test data with the data set.

Table 3. The Meaning of Homonym and Homophone Ambiguous Sentences with Similarity

Id	*Test Data for Homonym/Homophone Ambiguous Sentences*	*Homonym/ Homophone Ambiguous Sentence Data Set*	*Meaning*	*Ambiguous Kind*	*Percentage*
1	*Aku membeli selang untuk menyiram tanaman* (I bought a hose for watering plants)	*aku membeli selang air di toko* (I bought a water hose at the shop)	(Water dispensing device)	*Homonym*	61.97 %
		Selang satu jam dia langsung melahirkan (Within an hour she immediately gave birth)	Pause	*Homonym*	40.00 %
2	*Aku besok menabung di bank Jatim* (Tomorrow, I'm saving at the East Java bank)	*Saya menabungkan gaji di Bank* (I save my salary in the bank)	Place to save money	*Homophone*	59.70 %
		Bang tolong ambilkan bukuku di meja (Brother please get my book on the table)	Brother	*Homophone*	26.87 %

Sentences that are underlined are sentences that have the greatest percentage of similarity, so it can be concluded that the test data sentences have the same meaning as the sentences underlined. For example, the sentence "I bought a water hose at the store" has the same meaning as the sentence "I splash water with a long hose" the percentage of similarity between the two sentences is 61.97%. From these results it can be concluded that the test sentence has the meaning of a means of distributing water.

Fuzzy Ontology

Fuzzy Ontology is in charge of detailing the results of the meaning and converting the crips numbers into categorical numbers. With the aim that the results of the meaning of ambiguous sentences Homonyms and Homophones are easy to understand. Fuzzy Ontology divides the level of similarity with the membership function into 3 parts, namely low, medium, and high (Zhai, et al., 2008; Abou-of, 2020; Wang, et al., 2022). The following is an explanation of the three membership functions.

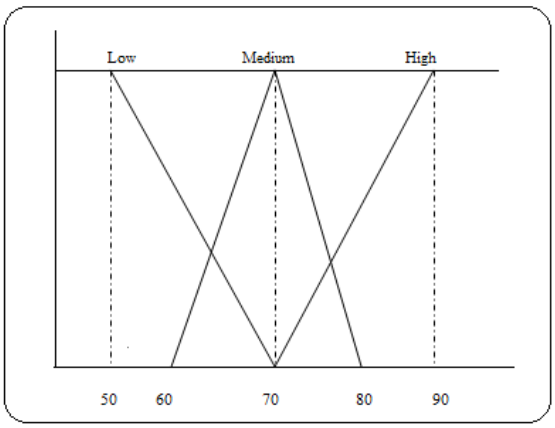

Figure 2. Membership function of ambiguous sentences Homonyms and Homophones

The Fuzzy Ontology Membership function is used to change the crips number resulting from matching data sets and test data. The fuzzy number membership function used has 3 levels first low, second medium, third high. Each of these membership functions has different equations, here are the similarities (Maeda, 1994; Gustian, et al., 2020).

Low Membership Function

The similarity value can enter into the low membership function if it is in the range of 50-70. A more detailed explanation of the low membership function is in equation (1).

$$\mu Low \begin{cases} 1 = x \leq 50 \\ \frac{70-x}{20} = 50 \leq x \geq 70 \\ 0 = x \geq 70 \end{cases} \quad (1)$$

Currently Membership Function

The similarity value can enter into the Currently membership function if it is in a range of 60-80. A more detailed explanation can be seen in equation (2).

$$\mu Currently \begin{cases} 0 = x \leq 60 \ atau \ x \geq 80 \\ \frac{x-60}{10} = 60 \leq x \geq 70 \\ \frac{80-x}{10} = 70 \leq x \geq 80 \end{cases} \quad (2)$$

High Membership Function

The similarity value can enter into the High membership function if it is in a range of 70-90. A more detailed explanation can be seen in equation (3).

$$\mu High \begin{cases} 0 = x \leq 70 \\ \frac{x-20}{20} = 70 \leq x \geq 90 \\ 1 = x \geq 90 \end{cases} \quad (3)$$

The membership function is used to convert the crips number into a categorical number. The purpose of changing the number of crips to be categoric so that the results of the meaning of ambiguous words are easy to understand. A more detailed description of the process can be seen in the table below.

Table 4. Homonym Ambiguous Meaning with Similarity and Fuzzy Ontology

Id	Test Data Sentences	Ambiguous sentence data set	meaning	Ambiguous Type	Similarity	Fuzzy Ontology
1	*Aku membeli selang untuk*	*aku membeli selang air di*	Alat menyalurkan	Homonym	61.97 %	Low

	menyiram tanaman (I bought a hose for watering plants)	*toko* ((I bought a water hose at the shop)	air (Water dispensing device)			
2	*Aku besok menabung di bank Jatim* (I'm saving tomorrow at the East Java bank)	*Saya menabungkan gaji di bank* (I save my salary in the bank)	Tempat menyimpan uang (Place to save money)	Homophone	59.70 %	Low

This number change is made to make it easier for deaf people to easily understand the level of ambiguity in a sentence. For example, the system inputs the sentence "*Aku membeli selang untuk menyiram tanaman* (I bought a hose to water the plants)" after in Similarity, it can be seen that the meaning of the sentence is "a tool to channel water" with a Similarity level of 61.97%. However, these results are not acceptable and difficult for deaf people to understand, therefore Fuzzy Ontology is needed to convert numeric numbers (crisp) into categorical ones. Converting numeric numbers (crisp) to categorical using fuzzy membership function. The value of Similarity results after processing with Fuzzy Ontology gets low similarity results. Based on this statement, it can be concluded that the level of similarity between the sentences "*Aku membeli selang untuk menyiram tanaman* (I bought a hose for watering plants)" with the sentence "I buy a water hose at the store" is 61.97% with a low similarity value.

3. Results and Discussion

Confusion Matrix is a method used to test the success of homonym and homophone ambiguous sentence meaning systems using fuzzy ontology. By utilizing the Confusion Matrix, the level of accuracy, precision and recall can be known. Here are the steps.

Homonym Ambiguous Analysis

Testing the meaning of ambiguous homonym sentences is very necessary, in order to determine the level of success of the system in understanding the meaning of red homonym ambiguous sentences. The test tool used to determine the level of success is the Confusion Matrix. By using the Confusion matrix method, the accuracy, precision, and recall values can be known (Mridha, et al., 2019; Xu, et al., 2020; Reddy & Supriya, 2021). The data tested with the Confusion Matrix is trial data, the test is carried out by entering 25 sentences containing ambiguous homonymous words and 25 sentences not containing homonymous ambiguous words. The following is a table of test results for the Confusion Matrix.

Description: TP = Homonym ambiguous sentence is known as ambiguous Homonym; FP =Ambiguous sentence Homonym known as unambiguous Homonym (failed); FN = Unambiguous sentence Homonym is known as ambiguous Homonym (sala translate) and TN = Unambiguous sentence Homonym is known to be unambiguous Homonym (successful).

Table 5. Confusion Matrix analysis ambiguous homonyms

Id	Sentence	TP	FP	FN	TN
1	*Aku membeli selang untuk menyiram tanaman* (I bought a hose for watering plants)	V			
2	*Bu guru rapat nanti jam satu* (The teacher's meeting will be at one o'clock)	V			

3	*Bisa ular sangat beracun dan mematikan* (Snake venom is very poisonous and deadly)	V
4	*Udang termasuk hewan berbuku* (Shrimp is a book animal)	V

Table 5 shows the results of testing homonym ambiguous sentences with the Confusion Matrix table. The table is marked according to the table description. After being classified, the entered sentence is then entered into the Confusion Matrix equation to determine the accuracy value, precision value, and recall value.

N=50	True	False
True	TP=23	FP=2
False	FN=0	TN=25

Figure 3. Homonym Ambiguous Meaning Testing with Confusion Matrix

Homonymous ambiguous sentences entered into the ambiguous word recognition system totalled 50 sentences. There are 25 homonymous ambiguous sentences, while 25 unambiguous sentences. After the trial results are carried out, the trial results are analysed using a confusion matrix. Here's the calculation.

$$accuracy = \frac{(TP+TN)}{TP+TN+FP+FN} \quad (4)$$

$$\frac{(23+25)}{23+25+2+0} = 0{,}96$$

Referring to equation (4), the accuracy of Homonymous ambiguous sentences in this experiment was 0.96. If this number is converted to a percentage, the system accuracy rate is 96%.

$$precision = \frac{TP}{TP+FP} \quad (5)$$

$$= \frac{23}{23+2} = 0{,}92$$

Referring to equation (5), the precision of homonym ambiguous sentences in this experiment was 0.92. If this number is converted to a percent, the system precision level is 92%.

$$Recall = \frac{TP}{TP+FN} \quad (6)$$

$$= \frac{23}{23+0} = 1$$

Referring to equation (6), the recall of homophone ambiguous sentences in this experiment is 1. If this number is converted to a percent, the system precision level is 100%.

Based on the calculation results, the precision value is 92%, accuracy is 96% and recall is 100%. Based on the results of the Confusion Matrix calculation, it can be concluded that the translator system runs well, because it has high accuracy and recall values.

Homophone Ambiguous Analysis

Testing the meaning of homophone ambiguous sentences is very necessary in order to determine the level of success of the system in understanding the meaning of homophone ambiguous sentences. To determine the level of success of the system in interpreting sentences, the Confusion Matrix is used, by using the Confusion Matrix method the accuracy, precision, and recall values can be known. The data tested with the Confusion Matrix is trial data (Cronk, 2001; Ghosh, et al., 2017; Park, et al., 2021). This test was carried out by inputting 25 sentences containing ambiguous homophone words

and 25 sentences containing no homophone ambiguous words. The following is a table of test results for the Confusion Matrix.

Description: TP=Ambiguous sentence Homophones are recognized as ambiguous Homophones; FP=Ambiguous sentence Homophone recognized unambiguous Homophone (failed); FN=unambiguous sentence Homophone recognized ambiguous Homophone (mistranslated); and TN=unambiguous sentence Homophone recognized unambiguous Homophone (success).

Table 5. Confusion Matrix analysis ambiguous homonyms

Id	Sentence	TP	FP	FN	TN
1	*Aku besok menabung di bank JATIM* (I'm going to save at the JATIM bank tomorrow)	V			
2	*Dia suka music Rock dari kecil* (He likes rock music since childhood)	V			
3	*Pabrik Djarum terletak di kabupaten Kudus* (Djarum factory is located in Kudus district)	V			
4	*Aku sedikit sangsi dengan peryataanmu tadi* (I'm a little penalized by your words earlier)		V		

Table 3 shows the results of testing homophone ambiguous sentences with the Confusion Matrix table. The table is marked according to the table description. After being classified, the entered sentence is then entered into the Confusion Matrix equation to determine the accuracy value, precision value, and recall value.

N=50	True	False
True	TP=24	FP=1
False	FN=1	TN=24

Figure 4. Testing the Ambiguous Meaning of Homophones with Confusion Matrix

Ambiguous Sentences Homophones entered into the ambiguous word recognition system totaled 50 sentences. Homophone ambiguous sentences are 25 sentences, while unambiguous sentences are 25. After the trial results are carried out, the trial results are analysed using a confusion matrix. Here's the calculation.

$$Accuracy = \frac{(TP+TN)}{TP+TN+FP+FN} = \frac{24+24}{24+24+1+1} = 0{,}96 \quad (7)$$

Referring to Equation (7), the accuracy value of Homophone ambiguous sentences is 0.96. If this number is converted to a percentage, the system accuracy rate is 96%.

$$Precision = \frac{TP}{TP+FP} = \frac{24}{24+1} = 0{,}96 \quad (8)$$

Referring to Figure (8), the Precision value of Homophone ambiguous sentences is 0.96. If this number is converted to a percent, the system precision level is 96%.

$$Recall = \frac{TP}{TP+FN} \quad (9)$$

$$= \frac{24}{24+1} = 0{,}96$$

Referring to Figure (9), the recall of ambiguous homophone sentences in this experiment was 0.96. If this number is converted to a percent, the system precision level is 96%

Based on the calculation results, we get a precision of 96%, an accuracy of 96% and a recall of 96%. Judging from the value obtained, the translation technology has been running well, because it has a high accuracy and recall value.

4. Conclusion

This Fuzzy Ontology is the basis for translating sentences containing ambiguous words Homonyms and Homophones, the success of this process in interpreting sentences greatly affects the translation results. After being measured using the Confusion Matrix, it can be seen the value of the success of the meaning of ambiguous homonym sentences and the ambiguous meaning of homophones. After being analyzed, the meaning of ambiguous homonym sentences has a precision value of 92%, recall 100%, and accuracy 96%. While the ambiguous meaning of Homophones has a precision value of 96%, recall 96%, and accuracy 96%. Meanwhile, judging from the almost equal amount of precision, recall, and accuracy, the meaning of ambiguous sentences of Homophones and Homonyms can be said to be successful. The results of this study can be used to improve the accuracy of the translation system when translating ambiguous sentences, either homonymous ambiguous sentences or homophone ambiguous sentences

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References

A. Bustamin, Indrabayu, I. S. Areni, and N. N. Mokobombang, “Speech to text for Indonesian homophone phrase with Mel Frequency Cepstral Coefficient,” Proc. - Cybern. 2016 Int. Conf. Comput. Intell. Cybern., pp. 29–31, Apr. 2017, doi: 10.1109/CYBERNETICSCOM.2016.7892562.

A.-H. Fakih, “Learning Through SMS in Saudi EFL Classroom: An Inter-University Study of Learner Perceptions and Achievement of Autonomy,” Theory Pract. Lang. Stud., vol. 12, no. 4, pp. 665–675, 2022, doi: 10.17507/tpls.1204.06.

B. C. Cronk, “Phonological, semantic, and repetition priming with homophones,” J. Psycholinguist. Res., vol. 30, no. 4, pp. 365–378, 2001, doi: 10.1023/A:1010403523434.

Batiari, N. M. P., Budiharto, B., & Suratmi, T. Anxiety in Adolescents: Risk Factors Based on the Social Ecological Model. (2022). INSAN Jurnal Psikologi dan Kesehatan Mental. 2022; 7(1): 36–53. https://doi.org/10.20473/jpkm.v7i12022.36-53

C. Ochs, T. Tian, J. Geller, and S. A. Chun, “Google knows who is famous today - Building an ontology from search engine knowledge and DBpedia,” Proc. - 5th IEEE Int. Conf. Semant. Comput. ICSC 2011, pp. 320–327, 2011, doi: 10.1109/ICSC.2011.50.

D. Gustian, B. Lestari, N. S. Rejeki, and N. M. Zasmine, “Fuzzy Inference System in Determining Nutritional Status of Toddlers,” 6th Int. Conf. Comput. Eng. Des. ICCED 2020, Oct. 2020, doi: 10.1109/ICCED51276.2020.9415781.

E. C. Dalrymple-Alford, “Lexical decisions with homophones and homonyms,” Curr. Psychol., vol. 3, no. 1, pp. 70–78, 1984, doi: 10.1007/BF02686534.

H.-S. Park, H.-J. Chang, and J.-D. Kim, “Homonym Comprehension and Definition of School-Aged Children with Language Learning Disabilities in First to Third Grades,” Audiol. Speech Res., vol. 17, no. 1, pp. 103–111, 2021, doi: 10.21848/ASR.200067.

I. Faško, “Orthographic and orthoepic diversity of Serbo-Slovak interlingual approximates,” Stud. z Filol. Pol. i Slowianskiej, vol. 51, pp. 58–71, 2016, doi: 10.11649/sfps.2016.005.

I. Hussain and S. Asghar, “LUCID: Author name disambiguation using graph Structural Clustering,” 2017 Intell. Syst. Conf. IntelliSys 2017, vol. 2018-January, pp. 406–413, Mar. 2018, doi: 10.1109/INTELLISYS.2017.8324326.

Isnaini, R., Pandin, M. G. R., Waloejo, C. S., & Sunyowati, D. (2022). Landslide and Moving Ground Disasters in Sumurup Village, Trenggalek District, East Java, Indonesia: A Case Study. IOP Conference Series: Earth and Environmental Science, 995(1), [012005]. https://doi.org/10.1088/1755-1315/995/1/012005

J. Xu, Y. Zhang, and D. Miao, “Three-way confusion matrix for classification: A measure driven view,” Inf. Sci. (Ny)., vol. 507, pp. 772–794, Jan. 2020, doi: 10.1016/J.INS.2019.06.064.

J. Zhai, W. Luan, Y. Liang, and J. Jiang, “Using ontology to represent fuzzy knowledge for fuzzy systems,” Proc. - 5th Int. Conf. Fuzzy Syst. Knowl. Discov. FSKD 2008, vol. 3, pp. 673–677, 2008, doi: 10.1109/FSKD.2008.326.

Ketut Sudarsana, I., Putu, I., Putra, A. W., Anam, F., Istianti, T., Pandin, M. G. R., Bhawika, G. W., Listiawan, T., Saddhono, K., Abdullah, D., Cathrin, S., Hadjri, M. I., & Laili, R. N. (2019). The Funcion of Technology and Device Laptop For Education Purpose. Society, and Technology Journal of Physics: Conference Series, 1363, 12062. https://doi.org/10.1088/1742-6596/1363/1/012062

M. A. Abou-Of, “A Fuzzy, Incremental and Semantic Trending Topic Detection in Social Feeds,” 2020 11th Int. Conf. Inf. Commun. Syst. ICICS 2020, pp. 118–124, Apr. 2020, doi: 10.1109/ICICS49469.2020.239492.

M. F. Mridha, M. A. Hamid, M. M. Rana, M. E. A. Khan, M. M. Ahmed, and M. T. Sultan, “Semantic error detection and correction in Bangla sentence,” in 2019 Joint 8th International Conference on Informatics, Electronics and Vision, ICIEV 2019 and 3rd International Conference on Imaging, Vision and Pattern Recognition, icIVPR 2019 with International Conference on Activity and Behavior Computing, ABC 2019, 2019, pp. 184–189. doi: 10.1109/ICIEV.2019.8858522.

M. Kadem, B. Herrmann, J. M. Rodd, and I. S. Johnsrude, “Pupil Dilation Is Sensitive to Semantic Ambiguity and Acoustic Degradation,” Trends Hear., vol. 24, 2020, doi: 10.1177/2331216520964068.

M. T. Kamowski-Shakibai and H. S. Cairns, “Kindergarten children can be taught to detect lexical ambiguities,” J. Child Lang., vol. 43, no. 2, pp. 442–456, Mar. 2016, doi: 10.1017/S030500091500015X.

Munir, M., Pandin, M. G. R., & Nor, M. R. M. (2022). Applying Bundo Kanduang Ethics' Principle on Society Facing Pandemic Covid-19 in Indonesia. Res Militaris, 12(2), 882-894.

O. Peleg, L. Edelist, Z. Eviatar, and D. Bergerbest, “Lexical factors in conceptual processes: The relationship between semantic representations and their corresponding phonological and orthographic lexical forms,” Mem. Cogn., vol. 44, no. 4, pp. 519–537, 2016, doi: 10.3758/s13421-015-0576-5.

P. Ghosh, T. S. Chingtham, and M. K. Ghose, “SLHAR: A supervised learning approach for homophone ambiguity reduction from speech recognition system,” Proc. - 2016 2nd IEEE Int. Conf. Res. Comput. Intell. Commun. Networks, ICRCICN 2016, pp. 12–16, Jan. 2017, doi: 10.1109/ICRCICN.2016.7813543.

P. P. Gokul, B. K. Akhil, and K. K. M. Shiva, “Sentence similarity detection in Malayalam language using cosine similarity,” RTEICT 2017 - 2nd IEEE Int. Conf. Recent Trends Electron. Inf. Commun. Technol. Proc., vol. 2018-January, pp. 221–225, Jul. 2017, doi: 10.1109/RTEICT.2017.8256590.

Pandin, M. G. R., Waloejo, C. S., Harivelo, R. Z. M., Tahir, W., & Naburi, N. D. (2021). Adaptive Capacity of Health Care System to Tsunami Disaster Impact Reduction in Sundanese Strait, Indonesia. Review of International Geographical Education Online, 11(3), 1216-1226. https://doi.org/10.33403/rigeo.800564

Peleg, et al., 2016; Wang, et al., 2023; Taladngoe & Esteban, 2022; Kadem, et al., 2020

Prakoeswa, C. R. S., Endaryanto, A., Martanto, T. W., Wahyuhadi, J., Rochmah, T. N., & Pandin, M. G. R. (2021). Mapping survey of community satisfaction at an academic hospital in Surabaya. Malaysian Journal of Medicine and Health Sciences, 17, 119-122.

Pramukti I, Strong C, Sitthimongkol Y, Setiawan A, Pandin MGR, Yen C, Lin C, Griffiths MD, Ko N., (2020) Anxiety and Suicidal Thoughts During the COVID-19 Pandemic: Cross-Country Comparative Study Among Indonesian, Taiwanese, and Thai University Students. J Med Internet Res 2020;22(12):e24487. doi: 10.2196/24487PMID: 33296867PMCID: 7772053

Pramukti I., Strong C., Chen I.H., Yen C.F., Rifai A, Ibrahim K., Pandin M.G.R., Subramaniam H, Griffiths MD, Lin C.Y., Ko N.Y. (2022). The Motors of COVID-19 Vaccination Acceptance Scale (MoVac-COVID19S): Measurement Invariant Evidence for Its Nine-Item Version in Taiwan, Indonesia, and Malaysia. Psychol Res Behav Manag. 2022;15:1617-1625. https://doi.org/10.2147/PRBM.S363757

R. A. Ramadhani, I. K. G. D. Putra, M. Sudarma, and I. A. D. Giriantari, “Detecting indonesian ambiguous sentences using Boyer-Moore algorithm,” Telkomnika (Telecommunication Comput. Electron. Control., vol. 18, no. 5, pp. 2480–2487, Oct. 2020, doi: 10.12928/TELKOMNIKA.V18I5.14027.

Rahim, R., Kurniasih, N., Daengs Gs, A., Saddhono, K., Riasti, B. K., Rangka, I. B., Kurniawan, D. E., Permana, E. P., Anam, F., Listiawan, T., Rumambo Pandin, M. G., Gumono, G., Yensy, N. A. B., Chandra Wardhana, D. E., Mustika, W. P., & Rindawati, S. (2019). Random and match game for education purposes with model learning technology system architecture. Journal of Physics: Conference Series, 1179(1). https://doi.org/10.1088/1742-6596/1179/1/012038

S. El-Sappagh, M. Elmogy, and A. M. Riad, “A fuzzy-ontology-oriented case-based reasoning framework for semantic diabetes diagnosis,” Artif. Intell. Med., vol. 65, no. 3, pp. 179–208, Nov. 2015, doi: 10.1016/J.ARTMED.2015.08.003.

S. S. S. K. Reddy and P. Supriya, “Detection of Wild Elephants Using Machine Learning Algorithms,” Proc. 2nd Int. Conf. Electron. Sustain. Commun. Syst. ICESC 2021, pp. 1897–1901, Aug. 2021, doi: 10.1109/ICESC51422.2021.9532827.

U. H. Peters, “Word plays and schizophrenic speech disorders - in what difference exists?,” Confin. Psychiatr., vol. 22, no. 1, pp. 58–64, 1979, [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-0018746293&partnerID=40&md5=6cd0800ca782b5031bf909401afe760d

U. Taladngoen and R. H. Esteban, “Assumptions on Plausible Lexical Distractors in the Redesigned TOEIC Question-Response Listening Test,” Learn J. Lang. Educ. Acquis. Res. Netw., vol. 15, no. 2, pp. 802–829, 2022, [Online].

Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85134701272&partnerID=40&md5=9b88a55744d07452a1b20eebb1b46fa7

V. Khisamova, L. Abdullina, L. Nurgalieva, and E. Khabibullina, "Classification of Homonymic Terms in Medical Terminology of English, Russian and Tatar Languages," J. Educ. Soc. Res., vol. 10, no. 6, pp. 18–34, 2020, doi: 10.36941/jesr-2020-0107.

Waloejo, C. S., Sulistiawan, S. S., Semedi, B. P., Dzakiyah, A. Z., Stella, M. A., Ikhromi, N., Nahyani, Endriani, E., Rahardjo, E., & Pandin, M. G. R. (2022). The Anesthetic Techniques for Earthquake Victims in Indonesia. Open Access Emergency Medicine, 14, 77-84. https://doi.org/10.2147/OAEM.S331344

X. Zhou and H. Zhang, "Flexible pattern matching algorithm in chinese strings," in Proceedings of the 27th Chinese Control Conference, CCC, 2008, pp. 610–614. doi: 10.1109/CHICC.2008.4604947.

Y. Lv, "Constructing fuzzy ontology based on fuzzy EER model," Proc. - 2010 7th Int. Conf. Fuzzy Syst. Knowl. Discov. FSKD 2010, vol. 3, pp. 1109–1113, 2010, doi: 10.1109/FSKD.2010.5569169.

Y. Maeda, "Ambigous state evaluation of fuzzy algorithm based on Fuzzy Petri Nets," IEEE Int. Conf. Fuzzy Syst., vol. 2, pp. 1230–1234, 1994, doi: 10.1109/FUZZY.1994.343646.

Y. Wang, Y. Jia, Y. Tian, and J. Xiao, "Deep reinforcement learning with the confusion-matrix-based dynamic reward function for customer credit scoring," Expert Syst. Appl., vol. 200, p. 117013, Aug. 2022, doi: 10.1016/J.ESWA.2022.117013.

Z. Eviatar, N. Binur, and O. Peleg, "Interactions of lexical and conceptual representations: Evidence from EEG," Brain Lang., vol. 243, 2023, doi: 10.1016/j.bandl.2023.105302.

Z. Wang et al., "Unpacking the relation between morphological awareness and reading comprehension in Chinese children," Br. J. Educ. Psychol., 2023, doi: 10.1111/bjep.12591.