Cyberbullying Detection Using Data Mining Techniques: A Survey

Omar Kamal
Business Information System, Helwan University, Cairo,Egypt
omkamalhussien2002@gmail.com

Amal Elsayed Aboutabl
Faculty of Computers & Artificial Intelligence, Helwan University, Cairo, Egypt
amal.aboutabl@fci.helwan.edu.eg

Riham Mohamed Haggag
Faculty of Commerce & Business Administration Helwan University, Cairo, Egypt.
rihamhaggagg@yahoo.com

Abstract -- Internet users are increasingly using social media websites like Twitter, Facebook, and Instagram spend a lot more time online with users. Online users can now readily communicate information with one another via computers, mobile devices, etc. Many strategies and procedures have been developed to date to control this problem to overcome it. This essay offers a study of cyberbullying and methods for identifying it. We have reviewed algorithms for cyberbullying detection in both Latin and Arabic languages using data mining techniques, and after comparing the highest accuracy of these classifications we will propose the techniques of Support Vector Machine (SVM), which achieved the highest accuracy among the various techniques applied in the cyberbullying detection in Latin and Arabic language between the techniques.

Keywords -- Social Media, Cyberbullying Detect, Classification, Data Mining Techniques.

— — — — — — — — — ◆ — — — — — — — — —

1. INTRODUCTION

The Internet allowed to exist opportunities for sociability and human engagement has been made possible. Social media in particular has had a boom in popularity over the last ten years. People are networking and communicating in ways that were previously impossible thanks to sites like MySpace, Facebook, Twitter, Whatsapp, Youtube, and Instagram. Due to the extensive use of social media among users of all ages, there is now a wealth of data available for a variety of study areas [1].

Social media is a platform that enables users to engage with others and share a wide variety of content, including images, videos, and documents [2]. Social media platforms like Facebook, YouTube, Instagram, and Twitter enable users to engage effortlessly and share thoughts, images, and videos while also offering each other support. Twitter is one of the most well-known social media platforms worldwide. Through tweets, users may engage and share their opinions on a variety of topics. Social media content, on the other hand, is difficult to monitor and presents severe problems because there is so much data available for people to access. Cyberbullying is the practice of certain users sending hurtful messages to other users [3].

Cyberbullying is defined as "willful and repeated harm inflicted through the medium of electronic text [4]. as they are the most active users of social networks, it primarily targets children and adolescents. Web 2.0 makes it simple and commonplace to access the internet, so cyber security is becoming a major problem.

Data mining techniques are the process of extracting specific information from data and presenting relevant and usable information that can be used to solve problems, including text mining, web mining, audio and video mining, picture data mining, and social network data mining [5], used to classification and clustering of these techniques and it may be utilized to detect cyberbullying in social media such as Logistic Regression (LR), Naive Bayesian (NB), Support Vector Machine (SVM), k-Nearest Neighbor (KNN), Random Forest (RF), Decision Tree (DT), Neural Networks (NN) These techniques have a powerful effect on detection.

2. RESEARCH METHODOLOGY

This paper aims to clarify the most recent understanding of cyberbullying based on literature reviews. Cyberbullying has been defined in a variety of ways in the papers and books that have already been written, which is useful for comprehending the term in diverse domains.

This study contains 20 different research studies on the topic of detecting hate speech or cyberbullying that have been published between 2017 and 2022.

Papers are collected from the articles in the period between 2017 and 2022 from standard sources such as research gate, IEEE, Explorer Springer, Google Scholar, etc.

2.1. Data Mining Techniques

This study presents a review study of the most used algorithms and more effective for the Detection of Cyberbullying.

2.1.1. Support Vector Machine

(SVM) supervised machine learning algorithm that can be applied to classification or regression issues. may classify the data by locating the hyper-plane that most accurately describes the two classes. Under the umbrella of machine learning, a support vector machine is a directed

learning method that can be applied to either classification or regression applications. But classification is where support vector machines are most often utilized. The foundation of support vector machines is the idea of building a hyperplane that best splits a dataset into two classes.[6]

2.1.2. Naive Bayes

(NB) A classifier is an algorithm that applies Bayesian probability to the processing of numerical input. categorization using Bayes statistics, which may forecast a class member's likelihood, used with representation statistics, this method is effective. Naive Bayesian can learn incrementally, in contrast to rule-based methods. However, the Nave Bayesian vector has a flaw in that the size of the resulting feature is relatively enormous, necessitating a method to reduce the size of the vector. [7]

2.1.3. Decision Tree

(DT) is an exploratory model that resembles a tree. Each branch of the tree accurately represents a taxonomic issue, and the leaves of the tree represent database elements that are a part of the established classifications. A decision tree is a visual tool that aids in decision-making by making it plain what options are available, what mistakes can be made, and what outcomes can be anticipated for each.[8]

2.1.4. Logistic Regression

(LR) is type of regression analysis techniques that are generally used to forecast the relationships between variables in a data set. LR is applicable if binary (0,1) is the dependent feature or the variable that was attempted to be predicted. The relationship between the dependent variable and the dependent variables can be used in LR models and is adaptable to a variety of data types, including numerical and categorical variables.[29]

2.1.5 Random Forest

RF is a flexible learning method that may be applied to classification and regression applications. While dealing with missing values, outliers, and other important processes in data exploration, it is also a technique for lowering the dimensions of the data and has produced positive outcomes. Additionally, it serves as a crucial technique for group learning because it excels at transforming multiple poor models into a single effective model.[30]

3. DETECTION CYBERBULLYING APPROACH

In this section, we present the most relevant works included in cyberbullying detection. We organized them based on the selected language Latin, collected dataset, features, and classification.

3.1. Detection in the Latin language

Desai, A., Kalaskar, S., Kumbhar, O., & Dhumal, R. (2021) proposes a model for the Detection of cyberbullying on Social Media using Machine Learning by using the BERT model. used the Twitter dataset for the sentimental analysis. The result of the accuracy of the Support Vector Machine (SVM) and Naive Bayes (NB) is 71.25% and 52.70% When applied to the Twitter dataset for the sentimental analysis, the model archived greater accuracy of 91.90%on same

dataset, which may be thought of as superior outcome compared to the conventional machine learning models.[9]

Jain, V., Kumar, V., Pal, V., & Vishwa karma, D. K. (2021) The following work builds a model for the detection of cyberbullying in text data using Natural Language Processing and Machine learning using a dataset from two different types of cyberbullying, hate tweets from Twitter and comments based from Wikipedia. the algorithm used Support Vector Machine (SVM), Logistic Regression (LR) & Naive Bayes (NB). The result of the model offers accuracy levels above 90% for data from Tweets and accuracy levels above 80% for data from Wikipedia.[10]

adav, N., Kudale, O., Rao, A., Gupta, S., & Shitole, A. (2021) in this work used Twitter data which is publicly available on Kaggle splitting into two sentimental categories, positive and negative, used the algorithm Support Vector Machine (SVM), Logistic Regression (LR) & Naive Bayes (NB). The higher accuracy is provided by linear (SVM), with 83.71. this study concluded that Using sentiment features rather than conventional text categorization results in higher accuracy.[11]

Bandeh, A., & Declan, O. (2020) In this study, the authors proposed a cyberbullying detection system for extracting features from the Twitter text. this paper created a file machine learning solution to detect and measure the severity of multi-category cyberbullying on Twitter based on these features. it is used to PMI along with the properties of embedding, feelings, and lexicon in the study. Used to Naïve Bayes (NB), K-Nearest Neighbours (KNN), Decision Tree (DT), Random Forest (RF), and Support Vector Machine (SVM). The result with an accuracy of 0.971 and an F-measure of 0.929, Random Forest was shown to be the best classifier in a classification environment. It is significant to notice that, when implemented with all suggested characteristics, accuracy increased from 0.894 to 0.971.[12]

Jalal, O. A. (2020) In this Study authors suggested a sentiment analysis approach for identifying texts that engage in cyberbullying on Twitter. used to supervise machine learning classification tools, this model employs Nave Bayes (NB) and Support Vector Machines (SVM). collected dataset tweets from Twitter that have been classified into positive, negative, or neutral cyberbullying. the result SVM classifiers have an average accuracy of 92.02%, while NB classifiers have an average accuracy of 81.1 On the 4-gram language model.[13]

Shah, R., Aparajit, S., Chopdekar, R., & Patil, R. (2020) This work used machine learning to identify cyberbullying content. it is collected of data in two ways:
The Twitter API and the tweets were obtained from the Kaggle dataset .used Logistic Regression (LR), Support Vector Machine (SVM), Random Forest (RF), Naïve Bayes (NB), Stochastic Gradient Descent (SGD). The result of the logistic regression, which has 91% precision, 96% recall, 93% F1 score, 93% accuracy, 90% specificity, 87% MCC, 9% fall out, and 3% miss rate, is the most accurate of all the classifiers.[14]

Hani, J., Mohamed, N., Ahmed, M., Emad, Z., Amer, E., & Ammar, M. (2019). In this paper supervised

machine learning can be used to detect and stop online bullying.. Cyberbullying behavior is trained and recognized using a variety of classifiers. this is used for the dataset from kaggle .it is a tested model using the Support Vector Machine (SVM) and Neural Network (NN), and for features extraction, we employed the TFIDF and sentiment analysis techniques. The categorizations were assessed using several n-gram language models. When combining TFIDF and sentiment analysis, it can achieve 92.8% accuracy using a neural network with three-gram inputs and 90.3% accuracy using an SVM with four-gram inputs. get to that the neural network outperformed the SVM classifier because it also produces an average f-score of 91.9%, compared to the SVM's f-score of 89.8%.[15]

Hani, N., & Dade, N. (2018)this study aimed to detect cyberbullying actors based on texts and analysis of reliable users to warn them of the dangers of such behavior. it is a collected dataset from Twitter. used Support Vector Machines (SVM) and K-Nearest Neighbor (KNN) to identify and learn about cyberbullying texts. the work successfully recognized tweets including cyberbullying with an F1 score of 67%... Additionally, assessed user credibility and

discovered 257 regular users, 45 harmful bullies, 53 bullies, and 6 potential bullies.[16]

Saha, S., Yadav, J., & Ranjan, P. (2017). this paper suggests a proposed model for Sarcasm detection on Twitter. The goal is to categorize the sarcastic tweets as positive, negative, or neutral using the Twitter data that was gathered using Twitter Archiver. , the accuracy, precision, recall, and F-score of the Naive Bayes (NB) and the Support Vector Machines (SVM) will be compared to classify the tweets. the result SVM has a 60.1% accuracy rate compared to 65.2% for Naive Bayes offers greater accuracy than the SVM classifier.[17]

Hariani, & Riadi, I. (2017) .The goal of this study is to examine how much cyberbullying has grown in Indonesia on Twitter and what kinds of cyberbullying are most frequently utilized by abusers. The study was conducted via data mining methods. it is collected from a dataset from Twitter. classification is carried out on clean data with weka. TF-IDF weighting and 10-fold cross-validation are used to validate the data before classification. Used to Naive Bayes (NB) The findings indicated that 86.97% of the content contained bullying and that 61.63% of cyberbullying incidents were related to psychology.[18]

Table 1: Overview of previous research about Cyberbullying Detection in the Latin language

NO	Author	Dataset	Tools Used	BEST Tool	Result
1	Desai, A., Kalaskar, S., Kumbhar, O., & Dhumal, R. (2021).	Twitter	SVM NB BERT	BERT	Accuracy 91.90%
2	Jain, V., Kumar, V., Pal, V., & Vishwa karma, D. K. (2021)	Twitter and Wikipedia	SVM LR NB	NB	Accuracy 94.95%
3	adav, N., Kudale, O., Rao, A., Gupta, S., & Shitole, A. (2021)	(Twitter) From kaggle	NB LR SVM	SVM	Accuracy 83.71%
4	Bandeh, A., & Declan, O. (2020)	Twitter	NB, KNN, DT, RF, SVM	RF	Accuracy 97.1%
5	Jalal, O. A. (2020)	Twitter	SVM NB	SVM	Accuracy 92.02%
6	Shah, R., Aparajit, S., Chopdekar, R., & Patil, R. (2020)	Twitter	LR, SVM RF, NB, SGD	LR	Accuracy 93%
7	Hani, J., Mohamed, N., Ahmed, M., Emad, Z., Amer, E., & Ammar, M. (2019).	(Formspring) From kaggle	NN SVM	NN	Accuracy 92.8%
8	Hani, N., & Dade, N. (2018)	Twitter	SVM KNN	SVM	F1-score 67%

9	Saha, S., Yadav, J., & Ranjan, P. (2017).	Twitter	NB SVM	NB	Accuracy 65.2%
10	Hariani, & Riadi, I. (2017) .	Twitter	NB	NB	Accuracy 86.97%

3.2. Detection in the Arabic language

Modern technology advancements have made it easy to identify cyberbullying. Arabic has a limited amount of study on cyberbullying. Here, we will include a few Arabic studies about cyberbullying.

ALBayari, R., & Abdallah, S. (2022). in this Study the aim of automatically detect offensive language on social in Instagram. it is collected from their datasets from social media to automatically identify the abusive language. 46,898 comments in all were given manual annotation labels. used the Kappa statistic in SPSS to assess the performance of several learning models such as the inter-annotator agreement used to (Logistic Regression (LR), Support Vector Machines (SVM), Random Forest (RF), and Naïve Bayes (NB). the result of the data demonstrates that the SVM classifier beats the other classifiers With an Accuracy of 69% for bullying comments and 85% for positive comments.[19]

Alghamdi, D., Al-Motery, R., Alma'abdi, R., Alzamzami,O., & Babour, A. (2021). The purpose of this study is to construct a two-level classifier model for Arabic violent writings. Text is divided into violent and non-violent categories at the first level. The second level categorizes violent text as either threatening or cyberbullying. The classifier models are created using the collected dataset. The total number of tweets in the dataset, which was compiled using the Python language's Tweet package and the Twitter API, is 3700. These tweets were gathered using 50 Saudi Arabian hashtags and common keywords. used two algorithms Support Vector Machine (SVM), and Naïve Bayes (NB). The proposed SVM-based and NB-based models' performances have been compared. With F1 scores of 76.06% and 89.18% and accuracy ratings of 73.35% and 87.79% for the first and second levels of classification, respectively, the SVM-based model performs better than the NB-based model.[20]

Alhashmi, A., & Darem, A. B. (2021). this study creates a Consensus-based Ensemble Cyberbullying Detection Model, this study aims to increase the effectiveness of the current cyberbullying detection models for Arabic content. the dataset collected from Twitter, Facebook, and YouTube has been translated into the Arabic

language. this is proposed used to algorithms such as Random Forest (RF), Neural Networks (NN), Naïve Bayes (NB), Support Vector Machines (SVM), and XGBoost (XGB). The result The suggested model outperformed RF and SVM,

the two most reliable classifiers for the Arabic language, by a total of 1.3%.[21]

Bashir, E., & Bouguessa, M. (2021). This paper investigates questions related to the content of how to protect Arabic texts from online abuse and bullying using data from Twitter. collected data from

Twitter them as CSV files All 36,056 tweets gathered for this study were about expletives in Arabic. used to algorithm Long-Short Term Memory (LSTM), (Logistic Regression (LR), Support Vector Machines (SVM), Random Forest (RF), K-Nearest Neighbor (KNN), Ridge Classifier (RDG), and Naïve Bayes (NB). All processes are applied to the same dataset with seven models of machine learning and LSTM. the result With an accuracy of 68%, the Random Forest classifier (RF) performs the best among the conventional classifiers, while the LSTM earns the best overall accuracy of 72%.[22]

Ali, R. T., & Kurdy, M. B.(2021). the authors this proposed of Arabic languages, particularly Syrian slang, on social media platforms, have proposed a method to identify cyberbullying content in Syrian slang on Facebook. is collected dataset from Facebook was chosen as the source of the data since it is most commonly used by Arabs, particularly the Syrian population. This approach is based on Data mining Algorithms. the result n comparison to other classifiers, Random Forest (RF), K-Nearest Neighbor (KNN), (Logistic Regression (LR), and Support Vector Machine (SVM) had the highest Accuracy of 76.8%, while the SGD model had the highest Recall rank of 49% and F1-Measure rate of 53%. Adaptive Boosting had the highest Precision rate of 94%. The (SGD) and (SVM) models' findings are somewhat more comparable than those of the other data mining methods in this study's other evaluation metrics.[23]

Almutairi, A. R., & Al-Hagerty, M. A. (2021). The main objective of this study is to identify and categorize Twitter bullying in Saudi Arabia's Arabic-speaking community. this approach Lexicon-Based Pointwise Mutual Information (PMI) to create a lexicon and Support Vector Machine (SVM) techniques are utilized to aid in the detection and classification of tweets. The dataset collected includes the Saudi student Exam, Saudi Vacation, and COVID-19. the result After applying the PMI, the F1-score is 50%; however, after applying the SVM to the resampling data, it is 82%. The results analysis demonstrates that the SVM method outperforms more effectively.[24]

Almutairi, S., & Abdel Fattah, M. (2021). the authors built an approach to Sentiment analysis for text analysis, opinion detection, and attitude classification. it applied to the Arabic language dataset that is automatically compiled using ArabiTools and the Twitter API. used Python and WEKA as data mining tools along with an SVM classifier. That the WEKA tool is superior to Python is demonstrated by the findings, which show that the WEKA accurately classified 15154 (85.3843%) tweets when used with the ArabicStemmerKhoja and (85.49%) tweets when used with Light Stemmer. Python correctly classified just tweets (84.03%). On the other hand, the Python tool performs admirably in terms of the time required to construct classification models. With the Light Stemmer, WEKA achieved an efficiency of 85.49% and completed the task in 352.51 seconds. With the ArabicStemmerKhoja, WEKA achieved an efficiency of 85.38% and completed the task in 212.12 seconds while Python has an efficiency of 84.03% and took 142.68 seconds.[25]

Farid, D., & El-Tazi, N. (2020).the researchers propose an enhanced model to detect cyberbullying on social networks by using sentiment analysis for the Arabic language Witter's Streaming API and Hashtag were used to construct a dataset comprising Modern Arabic, Egyptian Arabic Dialects, and Emojis for Sentiment Analysis. generated an average based on the data obtained for negative, neutral, and positive words, emojis, and words. The average computed accuracy for negative words and emojis was higher than 73%. The average accuracy determined for neutral and positive terms, on the other hand, was more than 85%.[26]

AlHarbi, B. Y., AlHarbi, M. S., AlZahrani, N. J., Alsheail, M. M., Alshobaili, J. F., & Ibrahim, D. M. (2019). the authors create an approach for Automatic social media bullying detection Twitter users that use text can analyze it using sentiment analysis. Automated sentiment analysis can be carried out using two different methods: rule-based, also known as lexicon or sentiment lexicon, and machine learning-based. A single file comprising around 100,327 tweets and comments was created after data was gathered via the Twitter API, Microsoft Flow, and YouTube comments. to extract the data, R was utilized. Used to Pointwise Mutual Information (PMI), Chi-square, and Entropy approach. the result PMI performed 81% better than Chi-square and Entropy, which gave results of 62.11% and 39.14%, respectively. The PMI technique also fared the best in terms of identifying cyberbullying when compared to Chi-square and Entropy approaches.[27]

Mouheb, D., Albarghash, R., Mowakeh, M. F., Al Aghbari, Z., & Kamel, I. (2019) .In this paper, machine learning was used to automatically identify Arabic-language cyberbullying. By employing the Naive Bayes(NB) classifier algorithm and real data for training and testing, the suggested method approach detects cyberbullying. collected the dataset that was used by Twitter API and YouTube to train and test the algorithm. This paper uses machine learning using the Naive Bayes classification algorithm based. The accuracy obtained by Naive Bayes Classification on the extracted Twitter and YouTube data set was 0.959.[29]

Table 2: Overview of previous research about Cyberbullying Detection in the Arabic language

NO	Author	Dataset	Tools Used	Best Tool	Results
1	ALBayari, R., & Abdallah, S. (2022).	Instagram	SVM LR NB RF	SVM	Accuracy 69%
2	Alghamdi, D., Al-Motery, R., Alma'abdi, R., Alzamzami, O., & Babour, A. (2021).).	Twitter	SVM NB	SVM	accuracy of 87.79%
3	Bashir, E., & Bouguessa, M. (2021).	Twitter, Facebook, and YouTube From (Chatcoder.com)	NN, NB, SVM, XGB and RF	RF and SVM	Accuracy 87.24% and 87.17%
4	Eman, B., & Mohamed, B. (2021)	Twitter	NB, LSVC, LR RDG, BNB, RF, KNN LSTM	LSTM	accuracy of 72%
5	Ali, R. T., & Kurdy, M. B. .(2021)	Facebook	SGD, SVM, ,RF, DT ,LR, NB, KNN, Adaptive Boosting	SVM	Accuracy 76.8%
6	Almutairi, A. R., & Al-Hagerty, M. A. (2021).	Twitter	PML SVM	SVM	Accuracy 82%.
7	Almutiry, S., & Abdel Fattah, M. (2021).	Twitter	SVM (WEKA) SVM (Python)	SVM (WEKA)	Accuracy 85.49%
8	Farid, D., & El-Tazi, N. (2020).	Twitter	sentiment analysis Hashtag	Hashtag 1	Accuracy 85%.
9	AlHarbi, B. Y., AlHarbi, M. S., AlZahrani, N. J., Alsheail, M. M., Alshobaili, J. F., & Ibrahim, D. M. (2019).	Twitter, Microsoft Flow, and YouTube	PMI Chi-square Entropy	PMI	F-score 81%
10	Mouheb, D., Albarghash, R., Mowakeh, M. F., Al Aghbari, Z., & Kamel, I. (2019)	Twitter and YouTube	NB	NB	Accuracy 95.9%

4. PROPOSED SYSTEM

this study is based on some observations we made after reviewing and comparing research papers. We learned about the five common actions made by our fellow authors after carefully examining the papers. These are the fundamental actions that every text classification method entails. Dataset, Data Pre-processing, Data Splitting, Feature Selection, and Classification.

4.1 Dataset

The most fundamental and crucial phase in any machine learning research is dataset collecting. Datasets must be clear, perfect, impartial, and diversified because they are what we feed to the algorithms. While conducting a literature review, we discovered that the real-time data was taken from many social media platforms, including Twitter, Facebook, Instagram, Wikipedia, and YouTube. we found a lot of stored on-site kaggle. Twitter was chosen as the best social media Because it provides many discussions and opinions on contemporary problems discussing a wide range of societal issues and so provides a significant volume of user opinions on a wide range of subjects.

4.2 Data Pre-processing.

The dataset may contain extraneous or unneeded information as well as negative text, symbols, and characters. The dataset must be cleaned up and superfluous data removed. Data cleansing is therefore necessary. The dataset is made acceptable and consistent for subsequent steps by data cleaning. Punctuation marks, special characters, retweet symbols, hashtags, numeric numbers, and URL were removed from the data at this stage because they had no bearing on the meaning of the statement. To prevent repetition, the sentences are changed to lowercase. To improve the accuracy and predictions of the model, additionally manually constructed a list of stop words for the English and Arabic languages and used them to eliminate these words from the clean data.

4.3 Splitting Dataset

The data is divided into training data and testing data after the pre-processing stage. The model is trained using the training data, as opposed to The model being assessed using testing data. Common 70:30 or 80:20 splitting ratios are used.

4.4 Training and Testing Dataset.

feature extraction is grouped once the dataset has been divided into training and testing datasets, and related features are classed as one group. classifier algorithms such as(SVM – NB – LR – SVC – KNN – RF – NN - DT – SGD – BERT) or Based Lexicons (Entropy - Chi-Square – PMI) will be assisted in learning to classify the data by the machine using the training set. The accuracy of our machine-learning model will be evaluated using the testing dataset after the machine has been trained.

4.4 Evaluation

calculated the accuracy of the classifier, precision, recall, and f-score of the positive, negative, and neutral tweets. Precision and recall are the metrics used to determine classifier output quality. Precision is the measure of how relevant the results are and recall is the measure of how many relevant results are returned. F-score is the average of both precision and recall.

5. CONCLUSION

The survey results show different Data Mining Techniques to detect cyberbullying in social media between 2017 and 2022. We conducted a thorough analysis of the evaluation procedures, characteristics, dataset size, language, and source of the most recent research in this area. To guide future research on this subject toward a more consistent and agreeable viewpoint on recent works, In addition, Twitter is the main source for the collected datasets. After comparing the highest accuracy of these classification techniques Support Vector Machine(SVM) achieved the highest accuracy among the various techniques applied in cyberbullying detection in both Latin and Arabic text cyberbullying.
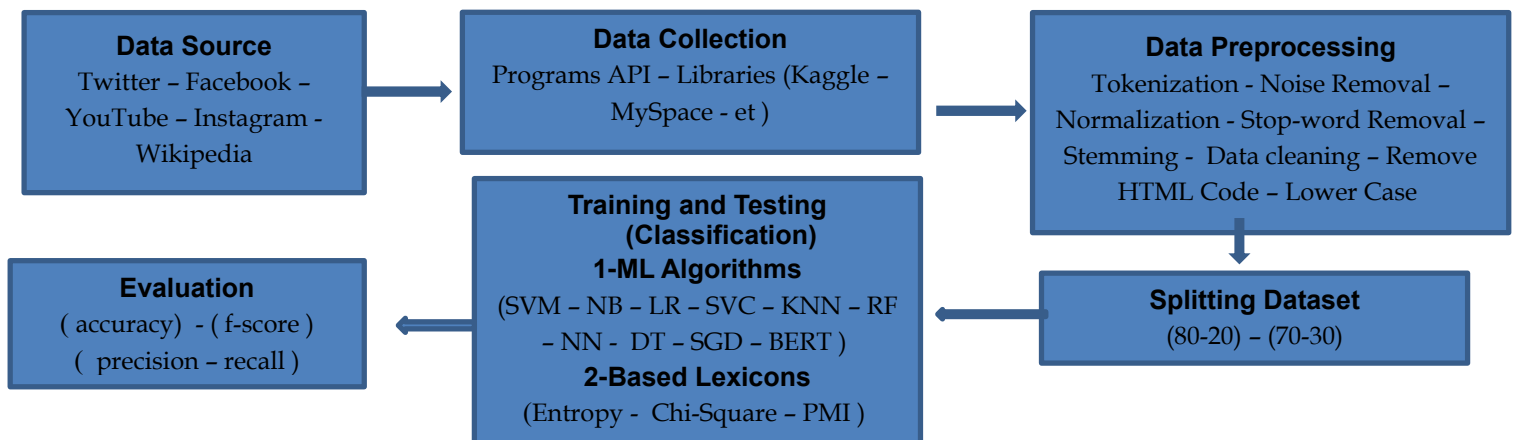

Figure1. Model of Detection Cyberbullying Data Mining Techniques

6. REFERENCES

[1] J. Tang, C. Aggarwal, and H. Liu, "Recommendations in signed social networks," in Proceedings of the International Conference on WWW,2016, pp. 31–40.

[2] Abro, S., Shaikh, S., Khand, Z. H., Zafar, A., Khan, S., & Mujtaba, G. (2020). Automatic hate speech detection using machine learning: A comparative study. International Journal of Advanced Computer Science and Applications, 11(8).

[3] Ting, I. H., Liou, W. S., Liberona, D., Wang, S. L., & Bermudez, G. M. T. (2017, October). Towards the detection of cyberbullying based on social network mining techniques. In 2017 International Conference on Behavioral,

Economic, Socio-cultural Computing (BESC) (pp. 1-2). IEEE.

[4] Patchin, J. W., & Hinduja, S. (2006). Bullies move beyond the schoolyard: A preliminary look at cyberbullying. Youth violence and juvenile justice, 4(2), 148-169.

[5] N. Rehman, "Data Mining Techniques Methods Algorithms and Tools", International Journal of Computer Science and Mobile Computing, (2017), 227-231.

[6] Abdulrahman, S. A., Khalifa, W., Roushdy, M., & Salem, A.-B. M., "Comparative study for 8 computational intelligence algorithms for human identification. Computer Science Review," 36, 100237, pp.1-11, 2020.

[7] F. R. Sandi. "Classification Of Posts Twitter Traffic Jams Of Bandung Using Naïve Bayesian Classification" Thesis, Master of Study Program Computer Science, University Of Gajah Mada, 2012.

[8] Nie, G., Rowe, W.; Zhang, L.; Tian, Y.; Shi, Y., "Credit card churn forecasting by logistic regression and decision tree," Expert Systems with Applications: An International Journal Vol.38, pp. 15273–15285, 2011.

[9] Desai, A., Kalaskar, S., Kumbhar, O., & Dhumal, R. (2021). Cyber Bullying Detection on Social Media using Machine Learning. In ITM Web of Conferences (Vol. 40, p. 03038). EDP Sciences.

[10] Jain, V., Kumar, V., Pal, V., & Vishwakarma, D. K. (2021, April). Detection of Cyberbullying on Social Media Using Machine learning. In 2021 5th International Conference on Computing Methodologies and Communication (ICCMC) (pp. 1091-1096). IEEE.

[11] Yadav, N., Kudale, O., Rao, A., Gupta, S., & Shitole, A. (2021). Twitter sentiment analysis using supervised machine learning. In Intelligent Data Communication Technologies and Internet of Things (pp. 631-642). Springer, Singapore[12] Talpur, B. A., & O'Sullivan, D. (2020). Cyberbullying severity detection: A machine learning approach. PloS one, 15(10), e0240924.

[13] Atoum, J. O. (2020, December). Cyberbullying Detection Through Sentiment Analysis. In 2020 International Conference on Computational Science and Computational Intelligence (CSCI) (pp. 292-297). IEEE.

[14] Shah, R., Aparajit, S., Chopdekar, R., & Patil, R. (2020). Machine Learning based Approach for Detection of Cyberbullying Tweets. Int. J. Comput. Appl, 175(37), 51-56.

[15] Hani, J., Mohamed, N., Ahmed, M., Emad, Z., Amer, E., & Ammar, M. (2019). Social media cyberbullying detection using machine learning. International Journal of Advanced Computer Science and Applications, 10(5).

[16] Nurrahmi, H., & Nurjanah, D. (2018, March). Indonesian twitter cyberbullying detection using text classification and user credibility. In 2018 International Conference on Information and Communications

[17] Saha, S., Yadav, J., & Ranjan, P. (2017). A proposed approach for sarcasm detection in Twitter. Indian Journal of Science and Technology, 10(25), 1-8.

[18] Riadi, I. (2017). Detection of cyberbullying on social media using data mining techniques. International Journal of Computer Science and Information Security (IJCSIS), 15(3).

[19] ALBayari, R., & Abdallah, S. (2022). Instagram-Based Benchmark Dataset for Cyberbullying Detection in Arabic Text. Data, 7(7), 83.

[20] Ohoud, A., & Amal, B. (2021).Automatic detection of cyberbullying and threats in Saudi tweets using machine learning. International Journal of Advanced and Applied Sciences. 8. 17-25. 10.21833/ijaas.2021.10.003.

[21] Alhashmi, A., & Darem, A. B. (2022). Consensus-Based Ensemble Model for Arabic Cyberbullying Detection. Comput. Syst. Sci. Eng., 41(1), 241-254.

[22] Bashir, E., & Bouguessa, M. (2021). Data Mining for Cyberbullying and Harassment Detection in Arabic Texts. International Journal of Information Technology and Computer Science, 13(5), 41-50.

[23] Ali, R. T., & Kurdy, M. B. Cyberbullying Detection in Syrian Slang on Social Media by using Data Mining.

[24] Almutairi, A. R., & Al-Hagerty, M. A. (2021). Cyberbullying Detection by Sentiment Analysis of Tweets' Contents Written in Arabic in Saudi Arabia Society. International Journal of Computer Science & Network Security, 21(3), 112-119.

[25] Almutiry, S., & Abdel Fattah, M. (2021). Arabic CyberBullying Detection Using Arabic Sentiment Analysis. The Egyptian Journal of Language Engineering, 8(1), 39-50.

[26] Farid, D., & El-Tazi, N. (2020). Detection of cyberbullying in tweets in Egyptian dialects. International Journal of Computer Science and Information Security (IJCSIS), 18(7), 34-41.

[27] AlHarbi, B. Y., AlHarbi, M. S., AlZahrani, N. J., Alsheail, M. M., Alshobaili, J. F., & Ibrahim, D. M. (2019). Automatic cyberbullying detection in Arabic social media. Int. J. Eng. Res. Technol, 12(12), 2330-2335.

[28] Mouheb, D., Albarghash, R., Mowakeh, M. F., Al Aghbari, Z., & Kamel, I. (2019, November). Detection of Arabic cyberbullying on social networks using machine learning. In 2019 IEEE/ACS 16th International Conference on Computer Systems and Applications (AICCSA) (pp. 1-5). IEEE.

[29] Sabbeh, Sahar F. "Machine-learning techniques for customer retention: A comparative study." International Journal of Advanced Computer Science and Applications 9.2 (2018).

[30] Jayaswal, Pretam& Prasad, Bakshi&Tomar, Divya&Agarwal, Sonali. , "An Ensemble Approach for Efficient Churn Prediction in Telecom Industry," International Journal of Database Theory and Application. 9, pp. 211-232, 2016.

Technology (ICOIACT) (pp. 543-548). IEEE.