A Study of Machine Learning and Artificial Intelligence in Controlling Domestic Violence

A

Synopsis

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1. Introduction:

Violence is considered one of the complex issues that affect the young adults, children, men and women across the world. Violence can occur in different ways that includes physical abuse, domestic violence, intimate partner violence, verbal abuse etc. There are various factors contributing to the increase in the violent behavior in individuals (Mary & Graham, 2012) [1]. Some of the basic factors that can stimulate violent behavior include traumatic experiences during childhood, exposure to perpetrators, complicated relationships, and subsistence survival strategies. The impact of these experiences can cause severe damage to the personality of individuals and can lead to various serious circumstances which can also lead to severe injury or death (Howard et al., 2010) [2]. Extreme violent behavior can also result in nonphysical problems such as depression, suicidal thoughts, post-trauma stress disorder, severe aggression, misbehavior and externalizing behavior (Murray et al., 2015) [3]. In most of the domestic violence cases registered, it was observed that the majority of the victims are female and the chances for women to be prey for domestic violence is higher compared to men. Apart from domestic violence, other problems such as physical injuries, health complications and mental health issues are some of the issues that make women more sensitive and finally result in violence by their male partners or family members (Richardson et al., 2002) [4] (Alshammari et al., 2018) [5] (Field et al., 2018) [6]. In general, domestic violence is correlated with other disparaging and harsh experiences that an individual is subjected during their childhood or adulthood. Since domestic violence does not occur in public places, it is often unnoticed and its severity is ignored most of the time. One of the general observations is that, most of the women who are the victims of domestic violence are not vocal about it and due to this they are not provided with required medical help and legal assistance (Fekadu et al., 2018) [7].

The public health regulatory identifies three levels of domestic violence prevention: primary, secondary, and tertiary (Wolfe & Jaffe, 1996) [8]. In primary prevention, the main focus is to minimize the occurrence of the incidence by preventing the first occurrence of violence act. Secondary prevention is to reduce the predominance of the issue after its occurrence which involves identifying the victims who are at greatest risk. And, tertiary prevention is implemented after accurately identifying the problem and once the issue is distinctly clear and damaging (Limbos et al., 2007) [9] (Matjasko et al., 2012) [10]. It is also not known that investigating

women about domestic violence in primary prevention would be acceptable to women are not. It was also evident from some of the community based surveys that most of the female victims wanted to be asked about domestic violence. And it was opined that women who were subjected to domestic abuse are not identified by healthcare professionals and the accuracy of the recognition has not been investigated. Several studies have suggested that most of the medical centres fail to identify the case of domestic violence on women despite the facial injuries (Caulthard et al., 2004) [11] (Rosen et al., 2020) [12]. Hence it is essential to design an intelligent system to identify the case of domestic violence among women by extracting information from unstructured texts to understand the issues in family when examined for abuse or violence. Recently with the emergence of machine learning and artificial intelligence, there has been significant transformation in the investigation process of domestic violence cases. These techniques are widely used for extracting valuable information from raw data in the form of texts (Xue et al., 2020) [13]. This study intends to employ machine learning tools to identify the domestic violence act by extracting the data from the texts and to perform different quantitative analysis. This research mainly focuses on determining the prevalence of domestic violence among women and to analyse the relation between various factors that result in domestic violence.

2. Literature Review:

(Subramani et al., 2019) [14] discussed the application of deep learning approaches for identification and classification of domestic violence from online posts. It was inferred from the study that the automatic text classification will reduce the issue of scalability and allows the domestic violence crisis support (DVCS) to address these issues immediately with the required assistance and guidance. Based on the problems related to domestic violence, the study develops a novel dataset named ‘‘gold standard’ and conducts an experimental analysis using different deep learning algorithms. These algorithms were trained in domain-specific knowledge for enhancing their performance. It was inferred from the results that these algorithms achieved 92% accuracy in predicting the classes and the performance was validated by testing these algorithms on real-time problems. (Chandramohan & Arunkumar, 2018) [15] proposed a machine learning based prediction model for identifying behavior of domestic violence. The proposed study will evaluate the big data obtained from social media websites and analyses the abusive behavior

using machine learning algorithms. The ML approach is used to identify different domestic violence cases such as crimes committed by children or adults, suicide etc. The study also discusses the possibility of understanding the temporal development of the association between different individuals of the network. (Subramani et al., 2018) [16] discussed the identification of domestic violence and its crisis based on the data obtained from Facebook posts. The study implemented deep learning techniques for identifying the victims of domestic violence. The proposed approach classifies different types of domestic violence cases with a superior accuracy of 94%. Comparative analysis showed that the proposed DL approach significantly outperforms other conventional machine learning algorithms. Additionally, results also validate the adaptability of this approach which will assist the researchers to develop techniques for identifying and assisting the victims of domestic violence. (Liu et al., 2018) [17] explored the impact of domestic violence on mental based on social media data. The data was collected from the Sina Weibo database where 232 victims with 77% of female victims and 232 non victims were collected. The mental healths of the victims from both the groups were analyzed four weeks before domestic violence occurs and four weeks after the domestic violence. An Online Ecological Recognition (OER) model was proposed in this study for analyzing the obtained data. The proposed model is based on various predictive algorithms for identifying the status of mental health of different individuals. The proposed approach determined enhanced accuracy levels in terms of prediction and classification. The status of mental health was determined based on weibo profiles and texts and it was observed from the results that victims showed increased depression levels with increased proneness towards suicide risks, and deteriorated life satisfaction after domestic violence. (Majumdar et al., 2018) [18] aimed to identify domestic violence by using facial recognition techniques. The study planned to identify commonly affected facial regions to identify different types of maxillofacial trauma related to domestic violence. The study also distinguished various categories of facial injuries which are caused due to domestic violence. By identifying and analysing the facial injuries, the study intends to help the concerned authorities to provide appropriate medical help to the sufferers along with required legal help. The proposed approach automates the mechanism of identifying and distinguishing the facial distortions of the domestic violence victims from others. In this context, the data was extracted from both domestic and non-domestic violence as individuals and using deep learning based activation maps, the images were categorized whether they belong to the class of domestic

violence or not. Results validate the effectiveness of the deep learning based approaches in accurately identifying the domestic injuries based on facial features.

3. Problem Statement:

Several women welfare organizations collect huge amounts of data in the form of unstructured texts which are used for identifying the domestic violence victims. In the past decades, this data is often analyzed manually which is a tedious process. Besides, the accuracy is compromised since these analyses were more prone to manual errors. With the recent advancements in machine learning and artificial intelligence techniques, they are widely used in identifying domestic violence at earlier stages. However, these models displayed poor performance with fundamental testing, and an additional investment of resources could not be justified to develop these models further. And there are very limited resources available to investigate the case of domestic violence against women since is is difficult to identify the accurate and genuine case.

Hence, it is essential to perceive that the existing literary works have various limitations and it needs to be resolved in order to strengthen the process of identifying domestic violence cases. More specifically, the method of aggregating data from text mining involves a lot of complexities in terms of preprocessing and feature extraction and classification. This research aims to identify such problems and resolve it to detect the domestic violence cases against women.

4. Research Objectives:

The main aim of the proposed research methodology is to control the domestic violence case based on the information obtained from unstructured text data which is collected from publicly available datasets. The prominent research objectives of this research are:

- To determine the prevalence of domestic violence among women
- To analyze the relationship between different factors that stimulate domestic violence such as traumatic experiences during childhood, unhealthy relationships etc.
- To analyze unstructured texts and to extract relevant information that identifies the act of domestic violence on women.
- To explore women's attitude of being asked about domestic violence by medical professionals.

- To improve the accuracy of the classification algorithm by automating the process using machine learning and artificial intelligence.

5. Research Methodology:

This research intends to predict the cases related to domestic violence against women using machine learning and artificial intelligence. The study proposes two machine learning algorithms such as Random Forest and Adaboost algorithms for classification and prediction of domestic violence cases. Random forest can be used for performing classification and regression tasks. In this study, RF is used for classifying people's opinion based on the aggregated data into and by performing regression analysis; RF predicts the case of domestic violence based on the classified data.

The proposed approach will be developed in three stages: theoretical assumption, model building process, and analyzing the performance of the model.

Stage 1: Theoretical assumption

This is the initial stage where the theoretical assumption is made based on the data generating mechanism i.e., different factors that lead to the development of a case study. The theoretical assumption integrates the data into the machine learning algorithm and helps in avoiding repeated testing of the data. This stage requires qualitative research analysis that involves genuine interviews and observations. The main aim of this stage is to identify the type of information required for our analysis.

Stage 2: Model building process

This stage is the important phase of this research since it involves the implementation of the proposed machine learning algorithms. This stage involves other subsections such as: data extraction, documentation of the obtained data, model development, and performance evaluation.

Data extraction is the initial stage where the data will be obtained from various possible data fields and datasets. This data will be used for developing summary reports of domestic violence. The second stage is to document the extracted data. The data will be labeled or tagged and are used to train the machine learning algorithms. In this stage, the ML algorithms will learn a particular function associated with text data and classifies according to the requirement. This document can also be used to compare the algorithms with other computer models in order to validate their classification accuracy. In the third stage, the proposed model will be developed using Random forest and Adaboost algorithms. Here, the model is trained based on the given classification problem. After developing the model, the next stage is to evaluate the performance of the proposed approach. The performance is evaluated with respect to different performance metrics such as accuracy, precision, recall, F1 score and ROC.

Stage 3: Performance Evaluation

This is the last stage of the implementation process where the performance of the proposed approach is compared with other existing algorithms to validate its efficiency.

5.1 Random forest -Adaboost algorithm:

Random forest is one of the enhanced ensemble learning algorithms constituted using multiple decision trees. It performs efficient classification and regression tasks. For 'N' samples, by using an individual decision tree, RF will perform a random selection process through the bootstrap resampling process and the obtained samples will be used for developing a decision tree, which collectively forms a random forest. In the RF process, the output of the classification process will be evaluated using a classification tree. The RF algorithm has various advantages compared to conventional techniques in terms of superior accuracy among various classification techniques and its efficiency in dealing with larger datasets and data samples with high dimensional functionalities, which reduces the need for performing dimensionality reduction. The Random forest approach is combined with another machine learning based Adaboost algorithm to improve classification problems Adaboost is capable of correcting the misclassifications found in different base algorithms. In this study, Adaboost is used for extracting relevant features from the unstructured text. It ensures a robust operational efficiency also proves to be adaptive and feasible for complex classification tasks.

6. Expected Outcome:

The preliminary objective of the proposed research methodology is to control the domestic violence against women by predicting the domestic violence cases from unstructured text. The study will use text mining to extract relevant information from the texts and to identify the domestic violence act by extracting relevant features from the text. The study proposes Random forest and Adaboost to perform these tasks.

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