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A Proposal on Sentiment Analysis in Social Media Text for Detecting Cyber Bulling & Hate Speech

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Abstract: online social networks are growing rapidly in various directions. A number of industries are using these platforms to promote their products and communicate with end clients. On the other hand, some communities are misusing such platforms to promote hate, violence and negative or bully contents. All these happening misbalance the social environment online and offline too. The proposed work offers a research proposal on online hate and bullies content detection by analyzing the text contents of the social media post, message, and blogs. In this context, machine learning techniques and sentiment features are involved as essential tools to deal with bulk amounts of data. This paper first introduces the complexities and needs of cyberhate and bully content problem then a survey is performed over recently available research contents. Further, basic design and functional aspects are provided for proposing a final data model. Finally the conclusion of the proposal offered with the next step of the proposed research work.

Keywords: sentiment analysis, text mining, natural language processing, cyber bulling, hate speech.

I. INTRODUCTION

Cyber-bulling and hate speech remains consistent similar to the conventional manner. It just changed their face, direct bulling or hate speech, impact negatively on the victim's mindset. This social menace is growing day by day on various social media platforms not only in India, around the world. These things not only affect teenagers but also effective for every age group. Spreading the suspicious text using different communication channels i.e. by emails, SMS, social media and others [1] is not acceptable. Therefore, text analysis techniques are useful for analyzing text and recovering hate and bulling pattern. These techniques are now in these days employed in different areas of applications i.e. medical, engineering, business, banking, education, and others, for prediction, recommendation, and decision making. But, simple text analysis and classification techniques are not enough for measuring the sentiments in text. Thus, NLP based text analysis is used for sensing the emotions and sentiments behind the text. NLP is an essential and strong concept for understanding text sentiments. It can be helpful for preserving human lives [2].

The proposed work is focused on discovering sentiment classes and intensity scores of text communication. The technique provides more than the sentiment classification; the aim is to find the sub-classes of sentiments classes. Additionally offers a sentiment score that helps to find the intensity of hate. This work is focused on the area of machine learning and NLP (natural language processing). The NLP is a domain of text classification and emotion discovery, in-text blocks [3]. The text available on social media, e-commerce product reviews, forums, micro-blogs, and others, can be used for sentiment analysis [4]. In this work, machine learning algorithms are used for analyzing the text in various public domains. Thus, a proposal on cyberbullying and hate speech detection is proposed to design and develop. Recently a number of contributions are provided by various authors in this domain. But most of them are limited to predicting negative or positive orientations and their sub-classes. But there are not suitable technique exist to answer the emotion's impact. Thus, the proposed work involves the design of a data model to measures the intensity of the bully or hate expressed in the text. Additionally, we tried to sub-categorize the emotion classes according to the intensity of sentiments.

II. BACKGROUND

This section provides a basic overview or understanding of the terminologies used in the research direction.

A. Machine learning

Machine Learning is a study that offers learning capability computers without being explicitly programmed. It gives knowledge to the computer by which it makes similar to the human brain: Learning ability [5]. Machine learning

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techniques are classified into three categories, depending on the nature of the learning examples or samples available to learn [6] are as follows:-

Supervised learning: in this learning process algorithm learns with examples. These examples are containing data as well as target response that is known as labels, classes or tags. After learning it predicts the response when new examples are introduced. This approach is similar to human learning under the supervision of a teacher. The teacher provides feedback to memorize, the specific examples [7].

Unsupervised learning: if an algorithm tries to learn directly from examples without any predefined response, and algorithm determine the data patterns is known as unsupervised learning. This type of algorithm restructures the data into some kinds of groups. They are quite useful in providing insights into the meaning of data and new useful inputs to supervised learning algorithms. It resembles the methods to figure out certain objects or events of similar classes, based on the degree of similarity between objects [8].

Reinforcement learning: The algorithm with examples that lack labels, as in unsupervised learning is termed as a reinforcement learning process. We can go with an example with positive or negative feedback is connected to applications for decision making, and the decisions bear consequences just like learning by trial and error. Errors help to learn because of added penalty i.e. loss of time, pain, and so on. An example of reinforcement learning is computers learn to play video games. The algorithm knows the outcome of actions it takes, and learning occurs while trying to avoid what it discovers to be dangerous to survival [9].

Semi-supervised learning: when incomplete training signal is available or training set with many target outputs or sometimes missing outcomes. Such a special cases of this principle known as Transduction of problem instances is known at learning time, except that part of the targets are missing [10].

B. Data mining

A huge amount of data is available in different Industries. This data is not useful until it is not transformed. It is necessary to analyze the data and extract useful information. Data mining involves different processes i.e. Cleaning, Integration, Transformation, Mining, Pattern Evaluation, and Data Presentation. Once all the processes are completed it will be able to use this information in many applications such as Market Analysis, Science Exploration, etc. Data Mining is defined as extracting information from data. Means data mining is the procedure of mining knowledge [11]. The knowledge extracted so can be used for the following applications [12]:

- Market Analysis and Management
- Corporate Analysis & Risk Management
- Fraud Detection
- Data mining techniques are used in various areas of production, science exploration, customer retention, sports, astrology, and the Internet.

Market Analysis and Management Listed below are the various fields of the market where data mining is used [13]:

Customer Profiling − DM helps in determining which type of people consume what kind of product and services.

- **Identifying Customer Requirements** − DM helps for recognizing the most suitable products or services for different consumers. It uses prediction to find the factors that may attract new customers.
- **Cross Market Analysis** – DM also helps to discover the Associations/correlations between product sales.
- **Target Marketing** − DM also used to discover clusters of customers that contribute to the same individuality i.e. benefit, spending habits, income, etc.
- **Determining Customer purchasing pattern** – DM can be used in determining buyers' purchasing habits.
- **Providing Summary Information** − Data mining provides us various multidimensional summary reports.

Corporate Analysis and Risk Management: Data mining is used in the following fields of the Corporate Sector [14]:

- **Finance preparation and quality assessment** − It includes cash flow investigation and forecast, dependent claim examination to assess assets.
- **Resource Planning** − It offers to summarize and judge against the resources and expenses.
- **Competition** − It engages scrutinize contestants and market instructions.

Fraud Detection: Data mining techniques are also involved in the domain of telecommunication and banking systems to detect frauds. During fraud calls or communication, learning techniques help to identify the destination, duration, time of the day or week, etc. It also analyses the patterns that deviate from expected norms [15].

C. Text mining

The aim of text mining is to analyse unstructured data, extract meaningful indices. Data can extract to derive summaries contained in the documents.

- **Information Retrieval (IR):** IR is an extension to document retrieval. The documents are returned into the form of features. Thus it first reduces the search space. Next, it focuses on the user query. It helps to narrow down the document size. Text mining also involves complex algorithms. And used with IR to speed up the analysis significantly [16].

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- **Data Mining (DM):** Data mining can describe as obtaining patterns in data. It can characterize as the extraction of the hidden patterns. Data mining techniques able to predict nature and future patterns. It allows businesses to make knowledge-based decisions.
- **Natural Language Processing (NLP):** NLP is one of the oldest and challenging problems. It is the study of nature by which computers can understand natural languages. NLP research pursues the question "how we understand the meaning of a sentence". What is used to understand? [17]

Text Mining applies in a variety of areas. Some of the most common areas are [18]

- **Web Mining:** Web contains a treasure of information. Web Mining is an extension of DM techniques to deal with the web data. That needs to discover hidden and unknown patterns from the Web. It is an activity of identifying the required information from web documents.
- **Medical:** Everyone wants to understand about diseases, to find therapies. The expert forums also represent seismographs for medical by E-mails, e- consultations, and requests.
- **Resume Filtering:** large enterprises receive thousands of resumes from job applicants. Extracting targeted information from resumes is not easy. Such kind of complex task can be automated by using text mining processes.

D. Classification

Classification is a data analysis task, i.e. the process of finding a model that describes and distinguishes classes and concepts. Classification is the problem of identifying a set of categories, on the basis of training data. For example: Before starting a project, need to check feasibility. Here, a classifier is required to predict class labels such as 'Safe' and 'Risky'. It is a two- step process [19]:

Training: Construction of Model using Different Algorithms by learning using the training set. The model has to be trained for the prediction.

Classification Step: Model used to predict class labels. It should be trained in order to get the accurate and best results.

E. Clustering

A cluster is a group of objects that belongs to the same class. Means, similar objects are grouped in one cluster and dissimilar objects are in another cluster. Clustering is the process of making a group of objects of similar objects. While doing clustering, first partition the set of data into groups based on similarity and assigns the labels. The advantage of clustering is that it is adaptable to changes and helps single useful features to distinguish different groups. Applications of Cluster Analysis are used in many applications such as market research, pattern recognition, data analysis, and image processing. Clustering can also help marketers to discover distinct groups in their customer base. And can characterize their customer groups based on the purchasing patterns [20].

Similarly in biology, it can be used to derive plant and animal taxonomies, categorize genes with similar functionalities and insight. Clustering also helps in the identification of areas of similar land. It also helps in the identification of groups of houses in a city according to type, value, and geography. It also helps in classifying documents for information discovery. It is also used in outlier detection such as credit card fraud. As a data mining function, clustering serves as a tool to gain insight into the distribution of data [21].

Requirements of Clustering

The following points on why clustering is required [22]:

- **Scalability**: scalable clustering algorithms are used to deal with large databases.
- **Capability to handle various type of attributes**: it is essential the algorithms should be capable to be applied on any kind of data.
- **Discovery of clusters with attribute shape**: The algorithm should be capable of detect clusters of arbitrary shape. They should not be bordered to only distance measures that flexible to find other clusters of small sizes.
- **High dimensionality**: The algorithm should not only be able to handle low-dimensional data but also the high dimensional space.
- **Ability to deal with noisy data**: Data with noisy, missing or erroneous data. Various algorithms are susceptible to data and may results poor cluster quality.
- **Interpretability**: The clustering consequences should be interpretable, logical, and usable.

Clustering Methods

Partitioning Method: for instance we have a database which contains n objects. The partitioning techniques develop k division of data. Each division characterize a cluster. It means, it will categorize the information into k clusters, which satisfy

(1) each group contains at least one object. (2) Each object must belong to exactly one group. For a given number

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of partitions, that method will create an initial partition. Then it uses the iterative technique to improve the partitioning by moving objects from one group to other [23].

Hierarchical Methods: This method creates a hierarchical decomposition of the set of data. It classifies hierarchical methods on the basis of hierarchical decomposition. There are two approaches [24]:

1. **Agglomerative Approach:** This is also known as the bottom-up approach. It establish with each object forming a separate group. It continuously combines the objects into groups that are closer to one another. It keeps on doing so until all of the groups are merged into one.
2. **Divisive Approach:** This approach is also known as the top-down approach. It starts with all of the objects in the same cluster. In the continuous iteration, a cluster is split up into smaller clusters. It is down until each object in one cluster or the termination occurs. Once a merging or splitting is done, it can never be undone.

Approaches to Improve Quality

Here, two approaches are used to advance the quality of clustering. First, carry out vigilant investigation of instance linkages at each hierarchical division. Next integrate agglomeration using an algorithm to group objects into micro-clusters, and then perform macro-clustering [25].

Density-based Method: The core concept is to maintain increasing the certain cluster as long as the density in the neighbourhood go above several threshold, i.e., for each data point within a cluster, the radius of a given cluster has to contain at least a minimum number of points [25].

Grid-based Method: In this method objects together form a grid. The instance space is quantized into limited number of cells that form a grid. The advantage of this method is fast. It is dependent only on the number of cells in each dimension [26].

Model-based methods: this method is hypothesized for each cluster to find the best fit data for a given model. This locates the clusters by density function. It reflects spatial distribution of the points. It provides a way to automatically determine the number of clusters, taking outlier or noise into account [26].

Constraint-based Method: In this method, clustering is performed by user or application constraints. Constraint refers to the user expectation or the properties of results. It provides us an interactive way of communication with the clustering process. It can be specified by user or application requirement [27].

F. Natural Language Processing

Natural Language Processing, or NLP, is defined as automatic manipulation of natural language, like speech and text, by computer algorithms. The study of NLP has been around for more than 50 years and grew out of the field of linguistics with the rise of computers. Natural language refers to the way we, humans, communicate with each other like, speech and text. We are surrounded by text and using signs, menus, email, SMS, Web Pages and other. We speak to each other, we write all these are text. It may easier to learn to speak than to write. Voice and text are how we communicate with each other. We must need methods to understand and reason about natural language, just like other types of data [28].

Essential real world applications

Automatic Summarization: In this era, the most valuable thing is data. We get useful and required amount of information from various sources. The information is overloaded and our access to knowledge far exceeds our capacity to understand it. We need an automatic text summarization because the flood of information over internet is not going to stop. Text summarization defined as the technique to create short, accurate summary of text documents. Text summarization will help us with relevant information in less time. NLP plays an important role in automatic text summarization [29].

Question-answering: Another application of NLP is question-answering (QA). Search engines put the information of the world at our fingertips, but they are still lacking comes to answer the questions. The companies like Google are working in this direction. It is a discipline of AI and NLP. It focuses on building systems that automatically answer questions by human. A computer system that understands the NL has the capability to translate the sentences into an internal representation so that the valid answers can be generated. The exact answers can be generated by doing syntax and semantic analysis. Lexical gap, ambiguity and multilingualism are some of the challenges for NLP in building good QA system [30].

Sentiment Analysis: Another application of NLP is sentiment analysis. Sentiment analysis is used to identify the sentiments among several posts. It is used to identify the sentiment where the emotions are not expressed explicitly. Companies are using sentiment analysis, an application of NLP to identify the opinion of their customers. It will help to understand what their customers think about the products and services. They can judge their reputation from customer posts with the help of sentiment analysis. Sentiment analysis understands sentiments in context to help us better understand what is behind the expressed opinion [31].

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G. Hate speech

Online hate speech takes place online, commonly on social media, with the purpose of targeting a person or a group based on religion, race, ethnic origin, disability, sexual orientation, or gender. It is the intersection of multiple tensions: [weasel words]. When the expression of different, between different groups; it is a vivid. It is a broad term, Multilateral and Multi- stakeholders processes. Hate speech continues increasing day by day and become a generic term [32]. It is mixing threats to individuals' and groups' security. Online line communication providers such as Facebook, Twitter, and Google started advancement on their own definitions of hate speech. National and regional bodies have need to promote understanding of that term. The Internet speed and reach makes it difficult for governments to enforce low in this environment [33]. Issues around hate speech bring into the emergence of private spaces for expression that serve in public e.g. Facebook, Twitter. The nature of hate speech and its relative to offline and achievement are extensively converse the nature of apparent hate speech and its probable penalty has lead to insertion much prominence on the solution and on how they should be grounded. Yet this focus has also limited deeper attempts to understand the causes underlying the phenomenon [34].

H. Cyber bulling

Cyber bullying is the harassment or bullying through digital devices like computers, laptops, and smart phones. The platforms where cyber bullying can occur include chat rooms, social media, and gaming where people can view and participate in the sharing content. The different types of bullying involve through hateful comments, SMS or messaging. It comprises posting, sending or sharing negative or false information. Do you find your child to be addicted to the smart phone? Has he/she become more limited and refuses to socialize? As parents, it can be quite concerning changes in child's behaviour. Beware! Your child may be experiencing the cyber bullying. Study about cyber bulling enables parents to report cyber bullying [35]. Following are some common types of cyber bullying [36]:

- Posting hurtful, nasty or rumours or comments about an individual
- Posting an awkward or horrible photograph or video
- Creating a fake or nasty webpage about an individual
- Issuing online threats provoking an individual
- Triggering religious, racial, ethnic or political vitriol online
- Faking an identity online to post personal or fake information about someone
- One obtains information of person's social media accounts and used it for online harassment, defamation and others.

With rising accessibility of affordable data services and social media, cyber bullying in India has observed a critical rise. According to studies, nearly 8 out of 10 are subject to the different types of cyber bullying. Among them around 63% appearance online abuses and invective, and 59% were focus to false rumours and gossips. Additionally various studies demonstrate India facing the highest cases of cyber bullying in the Asia. Specifically, 50% of women residing in Indian cities are victim of online abuse [37].

III. LITERATURE REVIEW

This section involves the recent contributions and efforts to provide the effective solutions using NLP based text analysis.

Vimala Balakrishnan et al [38] present a cyber-bullying detection model based on user personality. The aim is to recognize bullying patterns on Twitter. Random Forest, was used for classification underclass aggressor, spammer, bully and normal. Twitter features are a number of mentions, number of followers & following, popularity, favorite count, status count and a number of hashtags. Findings indicate that the user's personality improves cyber-bullying detection. Specifically, extraversion, agreeableness and neuroticism, and psychopathy were found to be significant. Experiments support existing studies and show the relationships between personality and bullying. The popular Sentiment analysis methods include support vector machine, naive Bayes, decision trees, and deep neural networks. These methods aim to distinguish one class from others. Text classification, are unsurprisingly fuzzy, therefore it is not clear, especially the fact that allocate labels to emotion in the text correspond to an agreed level of subjective opinion for multiple human annotators. This has motivated me to develop fuzzy methods. **Han Liu et al [39]** focus on cyberhate classification since the spread of hate speech via social media. They propose a modified fuzzy approach with two-stage training and classifying four types of hate speech, namely, religion, race, disability, and sexual orientation.

Multi-class sentiment analysis addresses the identification of the exact sentiment rather than the overall polarity of message. **Mondher Bouazizi et al [40]** introduce a different from the conventional multi-class classification. Refer to as ''quantification'', the identification of all sentiments within a post instead of attributing a single sentiment label. The proposed approach offers attributes scores to each sentiment in a tweet and selects the highest scores to judge. The authors study the quantification and propose an approach to classify 11 classes. Data set was manually labeled and the results of the analysis were checked against the human annotation. Experiments show the feasibility and reach an F1

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score equal to 45.9%. Assessment of sentiment from visual content has gained attention with the increasing tendency online. **Jufeng Yang et al [42]** investigates the visual sentiment analysis, involves an abstraction in recognition process. Authors propose a framework to leverage effective regions, using an off-the-shelf objectness tool, and employ a candidate selection method to remove redundant and noisy proposals. Then a convolutional neural network (CNN) is used with candidates to compute the sentiment scores and objectness score. The CNN outputs from local regions are aggregated with the whole images as final predictions. Experiments show that the algorithm outperforms the state-of-the-art approaches.

Corporations have desired customer experience about their products to stay ahead. A positive customer experience can be created by analyzing customer sentiments. Social networks represent intelligence and opinion of the public for real-time feedback. **Sandeep Ranjan et al [42]** research, a total of 153,651 tweets for 5 popular telecom brands were extracted to develop a prediction model using the sentiment score. The results were validated statistically. Positive sentiments about the brand are reflected by growth rate of subscribers. The sentiment results can be used to take timely actions for improving the customer experience. Human annotated Twitter data was collected by **Pete Burnap et al [43]** to train and test a supervised machine learning text classifier to distinguish between hateful and/or antagonistic responses. Classification features were derived from tweet. The results of the classifier can be robustly utilized in a statistical model to forecast the likely spread of cyber hate.

Social-networking and video sharing sites, etc. have drastically increased the shared textual & media resources. Moreover, the Web has become an effective platform to promote them. Significant data uploaded on YouTube contains objectionable content and violates guidelines. The presence of bullying & harassment-related videos is a major problem. **Shivraj Sunil Marathe [44]** has reviewed the existing approaches for detecting cyberbullying promoted through social networks. **Tijana Milosevic [45]** examines social media companies' responsibility in addressing cyber-bullying among children. Through analysis of bullying policies, they address bullying and examine the available evidence. This article signals concerns regarding transparency and accountability. And explains the process by which these policies develop and can influence the perceptions of regulators. This is based on a qualitative analysis of 14 social media policies and interviews with representatives, and experts.

According to **Imran Awan [46],** Facebook contains a growing number of virtual communities and hate groups who are using this to share violent, Islamophobic and racist narrative. It is important to analyze communities by monitoring the activities. Authors examined 100 Facebook pages, posts, and comments and found 494 instances of hate speech directed communities. **Pinkesh Badjatiya et al [47]** define this as being able to classify a tweet as racist, sexist or neither. They perform experiments with multiple deep learning architectures to learn semantic word embeddings to handle complexity. The experiments show that deep learning methods outperform. **Despoina Chatzakou et al [48]** present a principled and scalable approach to detect bullying and aggressive behavior. They propose a methodology for extracting text, user, and network-based attributes, and studying properties of bullies and aggressors. The authors evaluate the methodology using 1.6M tweets and show ML algorithms can accurately detect a user's behavior. **Ziqi Zhang et al [49]** introduce a method based on a deep neural network combining convolutional and long short term memory networks and conducts an evaluation of the method against several publicly available datasets. They show that the method outperforms state of the art on 6 out of 7 datasets. **Mai ElSherief et al [50]** deepen understanding of hate speech by focusing on a largely neglected but crucial aspect of hate speech – its target: either a specific person or entity or group. They perform linguistic and psycholinguistic analysis of hate speech and reveal the presence of interesting markers. Hate speech is dominated by religious hate and is characterized by the use of lethal words. The work provides a data-driven analysis of nuances of online-hate speech and its social implications and detection.

III. PROPOSED WORK

The aim of the proposed work is to study and improve the technique of the sentiment analysis for discovering hate speech and cyberbullying oriented posts in social media. In social media, people are free to post anything. Thus to monitor and make the clean surroundings of social networks the following objectives are established.

1. **To study and explore the techniques of cyberbullying and hate speech detection:** in recent years a significant amount of work found for social media text processing for recovering sentiment labels, a survey on existing techniques and tools of available sentiment analysis, hate speech, and cyberbullying is required. Thus this survey helps us to prepare a strategy for solution development.
2. **To extend and improve existing sentiment analysis techniques for automatic sentiment detection:** from the study of literature, the promising classification techniques are recovered to extend them for achieving higher performance in classification of sentiments. Additionally, the new features are incorporated to enable accurate identification of bullying and hate speech.
3. **To incorporate intensity and semantics of sentiment spread through text:** the previously offered sentiment analysis technique is modified here to find sentiment impact on the target person or community. Thus a score and scale are developed for measuring the hate and negative sentiments in the communicated text.

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4. **To study and compare the performance of the proposed cyberhate detection framework with respect to state of art technique:** the justification of the proposed model is tried demonstrated additionally the performance comparison of the proposed work with relevant available techniques is provided. In addition to that we tried to follow a real case using the available data and facts based on twitter.

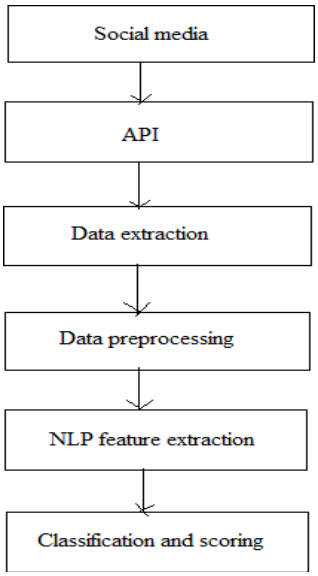

Figure 1 proposed data model

The proposed work is aimed to improve the existing technique of sentiment analysis. The extension is to include a scoring system for measuring the sentiment intensity based on delivered text. This scoring system is used with an application of cyberbullying and hate speech content detection system. Thus a basic model is demonstrated in figure 1. Thus twitter social media is selected for data collection and experimentation. In this context, we find different kinds of dataset resources online as well as offline mode. Additionally, social media platforms such as Twitter and Facebook also provide online API to query the data from real-time feeds.

After offloading the required data we need to improve the quality of raw offloaded data. Therefore first the data pre-processing is employed for improving data quality. Basically the offloaded data is in unstructured format means in text format therefore it contains various unwanted characters and stops words. The pre-process tried to remove from the offline contents. After content refinement the feature extraction techniques are used. Here we need to find some NLP or text- based feature selection approaches and their effectiveness to adopt in the feature extraction in the proposed model. Therefore NLP based features are computed here. The calculated features from the pre-processed text information are used with the supervised, semi-supervised and unsupervised learning techniques for finding the target patterns. That process is known as the training of the proposed system.

Finally, the proposed model produces the sentiment class for the given data. Basically we cannot decide the criticalness of a social media post in terms of polarity i.e. true or false. Therefore using the different available facts we are trying to compute a sensitivity score by which we can decide the intensity and negativity of a hate speech post. In this paper, we provide an overview of the proposed data model in the next article we provide the details about the given model.

V. CONCLUSIONS

Around the world, in various forms such as race, religion, body, physical ability, and others the bullying and hate are growing as a social menace. It is too sensitive and directly impacts on the target communities and target a person's mindset negatively. Additionally, the influence of social media and digital communication platforms are helping the haters to distribute the mischievous contents. In this context, the proposed work is an effort that helps us to capture and analyze the text contents from popular social media for finding the counterfeited contents. Using the proposed work initially the suspicious contents are identified which is prevented to be viral in different platforms and as a result, we can save various lives.

The proposed sentiment analysis based on hate speech and bullying detection technique includes the following future steps to achieve the required goal:

1. Involve a comparative performance study to find suitable sentiment based feature selection techniques and text feature selection technique

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2. Find an efficient and accurate classifier to deal with the text data and relevant feature set
3. Find some engineered features that help to establish the source credibilityLocate the source of compromised content and their possible channels of distribution for a target event.

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