An Intelligent Approach for Cyberbullying Detection and Prevention

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Abstract: Social media serves as a virtual playground for cyberbullying. It allows offenders to remain anonymous. It is also very challenging to track and makes difficult to detect bullying incidents. Detections become too crucial because of multi-model data such as text, image and video etc. In this case, automated detection and prevention techniques are necessary. The proposed research is to detect, prevent and alert cyberbullying instance with the help of multi – model deep learning enabled chatbot. The hybrid model is developed by combination of LSTM and CNN to handle the multiple inputs such as text, image and video in cyberbully detection. The chatbot was built with rasa framework. The model trained with built-in dataset and experiments conducted on real time dataset shows accuracy of 85% in text based cyberbullying and 86% in image based cyberbullying. Intelligent system monitoring the communication and the intelligent chatbot prevents the cyberbullying i.e. if an instance occurs it gives alert notifications. The system proved that deep learning based cyberbully detection and intelligent chatbot effectively handles cyberbullying events in Social Media.

Keywords: Cyberbullying, Chatbot, Deep Learning, Social Media, Multi-Modal, Hybrid Model, Cyberbullying Detection, Cyberbullying Prevention.

I. INTRODUCTION

Every day online users are increasing especially spending their time on social media devotedly and exchange their information. Internet and social media has the ability to connect and share information with anyone at any time with many people simultaneously. Due to increasing the use of social media technologies and applications, cyberbullying incidents are growing. The bully uses the technologies to harm the victim through online with different mode of bullying such as text, images, video and etc., by an aggressive method. During the Covid pandemic period the usage of digital gadgets are increasing and proportionately cybercrimes are growing during online chats. Only very few parents were aware that their child was a victim of cyberbullying. Early detection of cyberbullying committed by online bullies will prevent others from becoming victims. Awareness about safety of online users are instructed to the teenagers.

Early detection leads to better society. The adolescents and students need to be aware of the cyberbully incidents and how to react if it happen and report it.

Given the negative effects of cyberbullying on victims, it's critical to identify effective ways to detect and prevent it. The tools and software need to detect and block the predator if there are abuse messages. Preventing cyber bullying is understanding what children are doing and how they are vulnerable to an online abuser, then helping them teach how to respond when their well-being is defenseless by bullies, trolls, and other unsafe online users.

Recently, new tools were designed to simplify the interaction between humans and computers. Chatbots are one of the most effective techniques, since it plays major role in education, insurance, banking, customer service and etc. based on requirements. It is artificial intelligence software that can imitate a natural language interaction with a user via messaging apps, websites, or mobile apps. It can be used to deal with cyberbullying issues that can communicate automatically and provide appropriate preventive conversation. BotSupply co-creates the chatbot to resolve problems like reporting incidents, asking for advice, and accessing information to help the victims to cope with cyber bullying and online abuse in Danish language ("BotSupply - Save the Children Chatbot". 2021).

This paper is organized as follows. Section 2 presents a detailed review of literature related to cyberbullying detection and cyberbully prevention. The proposed intelligent chatbot development presented in the Section 3. The experimental results are discussed in Section 4, and conclusion and future work in Section 5.

II. REVIEW OF LITERATURE

Many researchers introduced many approaches to detect and prevent cyberbullying in social media. And also several prominent studies are presented to detect and prevent cyberbullying in the recent years. The detailed literature review is prepared and presented based on previous cyberbully detection, algorithms, dataset used and interaction.

i.Cyberbully Detection

A detailed survey of cyberbullying detection and prevention is conducted based on approaches to automate detect the events which covers machine learning and natural language processing (Salawu & Lumsden, 2020). Chris Emmery presented a study on limitation of cyberbully detection focus on cross-domain generalization of classifiers (Emmery et al., 2020). A comprehensive study on machine learning approach based cyberbullying Natural Language Processing and Machine Learning detection (Malpe & Vaikole, 2020). Thabo Mahlangu presented a study in cyberbully detection methods (Mahlangu et al., 2019). H. Rosa presented on automatic cyberbully detection Natural Language Processing and Machine Learning (Rosa et al., 2019).

A survey on content based cybercrimes which includes cyberbullying (Singh & Kaur 2019). Detection of cyberbullying in social media text based on cyber victimization is proposed by Cynthia (Van Hee et al., 2018). Cyberbullying detection based on dark triads is proposed by Sanchez (Sánchez-Medina et al., 2020). Cyberbully detection using Formspring.me, Myspace

and Youtube datasets is done through multiple machine learning algorithms (ACI, et al., 2019). A hybrid deep learning model consist of Bi-GRU and CapsNet is proposed by Akshi Kumar (Kumar & Sachdeva, 2021). A deep reinforcement Learning for text based cyberbullying detection is proposed by N. Yuvaraj (Yuvaraj et al., 2021). Data sources like Wikipedia, Twitter and Formspring text comments are used to develop a deep learning model for detecting cyberbully is done by Maheep Mahad (Maheep, 2021). Classification using deep decision tree method to identify cyberbullying is proposed by Natarajan Yuvaraj (Yuvaraj et al., 2021).

A hybrid DNN model with combination of CNN and LSTM is proposed by Hugo Rosa (Rosa et al., 2018). Multi model for cyberbully detection is proposed by Pradheep (Pradheep et al., 2017). Multiple models including CNN, LSTM BLSTM are used in detection (Dadvar, & Eckert, 2020). Convolutional Neural Network (CNN) model is proposed by multiple authors in various cyberbully detection methods (Georgakopoulos et al., 2018; Nguyen et al., 2020; Banerjee et al., 2019; Patange et al., 2019). L Cheng done works in multi model cyberbully detection (Cheng et al., 2019a; Cheng et al., 2019b; Cheng et al., 2019c). V. Vijayakumar proposed a deep learning method using Convolutional Neural Network (CNN) to detect Cyberbullying in images (Vijayakumar et al., 2021a). An image based cyberbullying detection and prevention was done by V. Vijayakumar by Convolutional neural networks (Vijayakumar et al., 2021b). Multi – Input hybrid text, image and video based detection is done by V. Vijayakumar (Vijayakumar et al., 2021c). Detection of cyberbullying events using bots are suggested by Bhatt from University of Illinois (Communications, 2021). Researcher from Binghamton University detects Cyberbully events using twitter with 90% accuracy in 2018 ("New algorithm can distinguish cyberbullies from normal Twitter users with 90 percent accuracy - Binghamton News", 2021).

ii.Cyberbully Prevention

Commercially, chatbots have been used to deal with mental health difficulties, collecting feelings and leading to desired emotional states. It can be a viable alternative for dealing with online abuse, either by preventing or stopping it. Cyberbullying prevention aid to educate students with the help of chatbot (Cohen et al., 2018). Tay AI chatbot released by Microsoft via Twitter to mimic and converse with users in real time as an experiment for conversational understanding. SimSimi is an intelligent chatbot that has been repurposed as a cyberbullying companion that people may interact with, while other users can anonymously programme it to respond to specific phrases. Nishant Vishwamitra et al. created MCDefender, a mobile cyberbullying defence system (Lee, 2021). VIAFONE Technologies has developed an Artificial Intelligence Chatbot “Bully Bot” for a secure future against cyberbullying ("Etisalat’s Bully Bot", 2021). The CREEP (Cyberbullying Effects Prevention) project aims to develop new technologies for the early detection of online bullying by monitoring social media in 2017, as well as offering preventive advice and recommendations to teenagers through a chatbot ("Identifying and preventing the possible negative effects of cyberbullying on young people", 2021; "CREEP: FIGHTING CYBERBULLYING WITH ARTIFICIAL INTELLIGENCE", 2021). In 2016 WatsomApp is powered with IBM is using chatbot to detect cyberbullying ("WatsomApp", 2021; "WatsomApp - Primer método online que detecta y

previene el acoso escolar", 2021). The key challenges associated to the design of a chatbot include interaction style, tasks and trust.

III. PROPOSED RESEARCH WORK

The proposed research framework developed an intelligent chatbot based hybrid deep learning model that can interact with humans and identify cyberbullying events in social media platforms is shown in the Fig. 1.

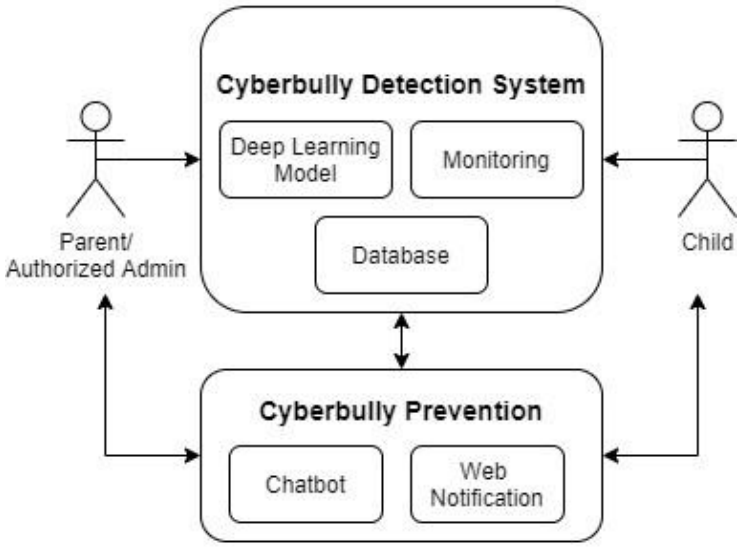

Figure 1: Proposed Research Framework

The framework consists two phases such as cyberbully detection and cyberbully prevention:

1. Multi-model based Hybrid - Deep Learning Detection

Step 1: Training the Detection Model

The model is trained with benchmark training dataset. Text data is taken from Kaggle Toxic Comment Classification Challenge dataset ("Toxic Comment Classification Challenge | Kaggle", 2021) and The NSFW scrapped image dataset taken from the Alexander Kim GitHub repository which contains URLs of the image scrapped from different source of internet ("GitHub - alex000kim/nsfw_data_scraper: Collection of scripts to aggregate image data for the purposes of training an NSFW Image Classifier", 2021).

Step 2: Detection Model development

The detection model is developed in step by step method.

i. Preprocessing: In text, inputs are tokenized. The image data is converted into fixed size i.e. 90 X 90.
ii. A hybrid algorithm is developed with Convolutional Neural Network (CNN) for image and Long Short-Term Memory (LSTM) for text.

iii. The Hybrid Predictive Model CNN and LSTM layers are concatenated by using Keras functional API.
iv. The Rectified Linear Unit (ReLU) activation function is applied.
v. The model is tested manually.

2. Cyberbully Prevention

The proposed Hybrid Predictive CNN and LSTM Model used to monitor interactions of registered users. An Intelligent chatbot is developed to cyberbully prevention. It can be used with web application or social media applications such as Telegram. The user can establish direct communication with the bot. Chatbot is pre-trained with possible question answer scenario according to the situation. Initial interactions are constructed by user requirements with the help of buttons. Data is taken from registered user and based on communication, bot notifies about the bully event and request to take necessary actions.

Step by step development:

Step 1: Chatbot Configuration

The proposed chatbot is developed by using Rasa Open Source (version 2.8) framework. It is a command line interface of Rasa X. To communicate with web interface socketIO is enabled. To interact as Telegram bot, credentials are collected from BotFather, a bot which helps to build bots in Telegram, by providing name and username. API ID, API HASH, things needed to be specified in chatbot communication, is obtained from BotFather and recorded in the rasa "credentials.yml" file. The credential file holds all the credentials for Rasa. A server pipeline is created by Ngrok, a software which used to access a web server currently running on your local machine to internet. The port number is specified which is to be listened. A temporary hosting can be done using this.

Step 2: Monitoring

Telethon, a python API library used for interacting and monitoring in Telegram. Every upcoming messages are analyzed by the hybrid multimodal deep learning server. Text and images results are verified and if detected for cyberbullying, it is displayed/notified to client as labels by chatbot and also website. Alert notifications are generated to parent, child and authorities about the incident.

Step 3: Prevention (User Communication & Alert)

Prevention is required to terminate any type of harm caused by the bully to the victim. If any cyberbullying event is detected by the multi input deep learning model, the system generates alert notification through chatbot and web notification. In telegram bot the status of the bully incident is displayed.

The detailed process diagram is shown in Fig. 2.

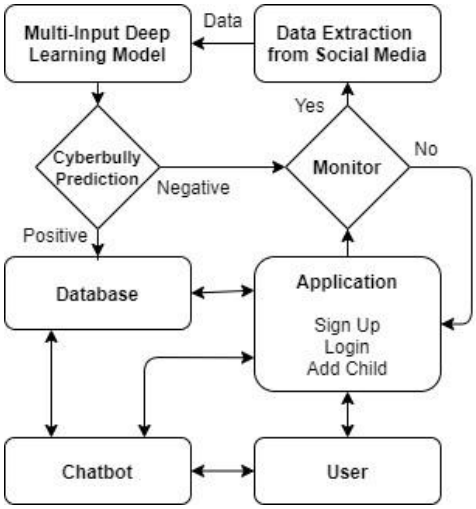

Figure 2: Cyberbully preventive process

IV. EXPERIMENTAL RESULTS AND DISCUSSION

i.Cyberbully Detection

The proposed deep learning model developed and tested using Intel i5 processor system with 8 GB RAM and 1 MBPS Internet speed. The system has in-build GPU Intel UHD Graphics, installed Windows 10 Operating system and configured the Python libraries like rasa, rasa-sdk, cv2, Numpy, Tensor flow and Keras. The trained model is shown in the Fig. 3.

Model: "model_1"

Layer (type)	Output Shape	Param #	Connected to
text_inp (InputLayer)	[(None, 200)]	0	
embedding_1 (Embedding)	(None, 200, 128)	2560000	text_inp[0][0]
img_inp (InputLayer)	[(None, 90, 90, 3)]	0	
lstm_layer (LSTM)	(None, 200, 60)	45360	embedding_1[0][0]
conv2d_2 (Conv2D)	(None, 88, 88, 32)	896	img_inp[0][0]
bidirectional_1 (Bidirectional)	(None, 200, 120)	58080	lstm_layer[0][0]
max_pooling2d_2 (MaxPooling2D)	(None, 44, 44, 32)	0	conv2d_2[0][0]
global_max_pooling1d_1 (GlobalM	(None, 120)	0	bidirectional_1[0][0]
conv2d_3 (Conv2D)	(None, 42, 42, 16)	4624	max_pooling2d_2[0][0]
dropout_4 (Dropout)	(None, 120)	0	global_max_pooling1d_1[0][0]
max_pooling2d_3 (MaxPooling2D)	(None, 21, 21, 16)	0	conv2d_3[0][0]
dense_7 (Dense)	(None, 128)	15488	dropout_4[0][0]
flatten_1 (Flatten)	(None, 7056)	0	max_pooling2d_3[0][0]
dropout_5 (Dropout)	(None, 128)	0	dense_7[0][0]
dense_5 (Dense)	(None, 256)	1806592	flatten_1[0][0]
dense_8 (Dense)	(None, 256)	33024	dropout_5[0][0]
dense_6 (Dense)	(None, 84)	21588	dense_5[0][0]
dropout_6 (Dropout)	(None, 256)	0	dense_8[0][0]
concatenate_1 (Concatenate)	(None, 340)	0	dense_6[0][0] dropout_6[0][0]
dense_9 (Dense)	(None, 128)	43648	concatenate_1[0][0]
dropout_7 (Dropout)	(None, 128)	0	dense_9[0][0]
img_out (Dense)	(None, 2)	682	concatenate_1[0][0]
text_out (Dense)	(None, 6)	774	dropout_7[0][0]

Total params: 4,590,756
Trainable params: 4,590,756
Non-trainable params: 0

Figure 3: Hybrid Multi-Modal Detection Summary

The detection model is trained with 4,590,756 parameters with separate input and output for text and image. Few layers of Dense layers are added with these models. These layers are concatenated. At final the prediction results are collected separately as two outputs based on the text and image class. The performance of the prediction is measured based on the accuracy. The model attained 85 % in text classification and 86% in image classification accuracy.

ii.Cyberbully Prevention

The registration and login are done through web interface is shown in Fig. 4. Admin/User registration is created through a web interface and name, password etc. are recorded in database. A child is added to the cyberbully detection system by inserting any social media account of the child. A button is used for initiate monitoring. Monitoring Section is shown in Fig. 5.

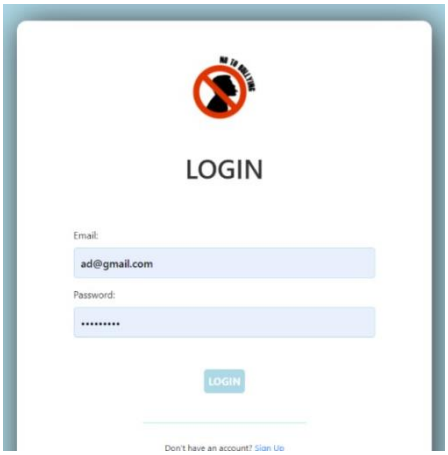

Figure 4: Registration

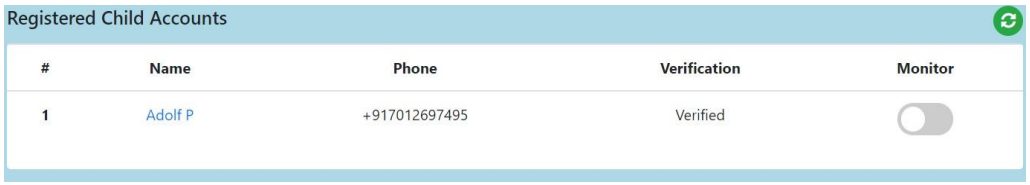

Figure 5: Monitoring toggle button

A form is created to add child for monitoring process. Required inputs needed to be given by the user. All new messages received by the child is monitored by the automated system. If any cyberbully event is detected in the deep learning model, an alert notification is send to the user as web and chatbot notification. Alert generation and operations are shown in Fig. 6.

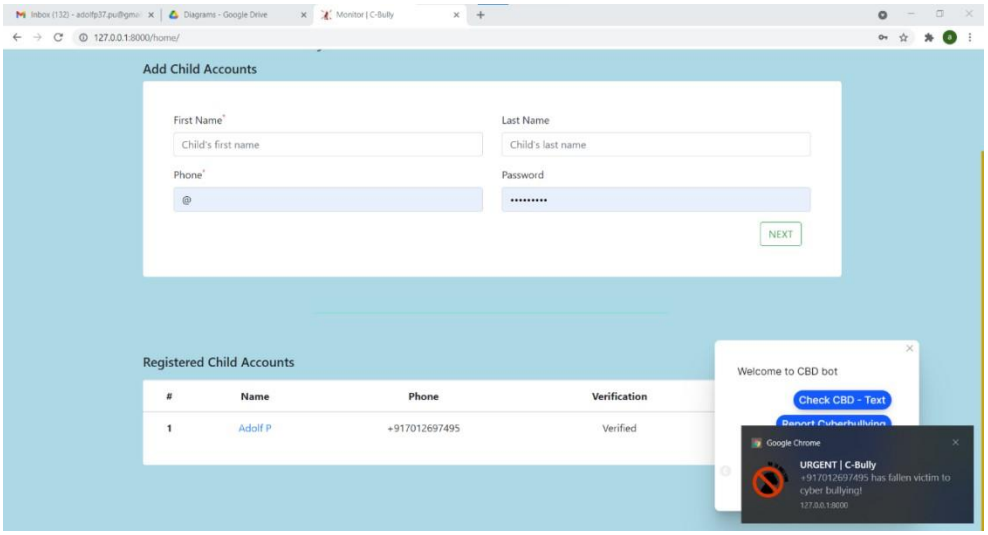

Figure 6: Alert generation

The bully details are stored in a MongoDB database. On clicking on web notification, it directs to the cyberbully data stored in the database. The database stores sender ID, sender name, message received and media. Samples of cyberbully event data is shown in Fig. 7.

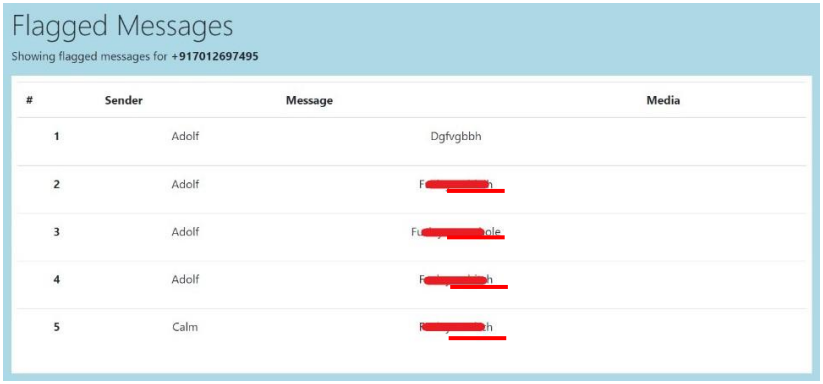

Figure 7: Cyberbully event list

A chatbot service integrated with Telegram bot is used to retrieve the bully details remotely. The registered user can provide input child monitoring mobile number to fetch details about the status of monitoring and cyberbully events stored in the database. The interaction with Telegram bot is shown in Fig. 8. Screen 1 display a registered number but no longer actively monitoring. Screen 2 and 3 display a registered number which is actively monitoring and stored cyberbully incidents.

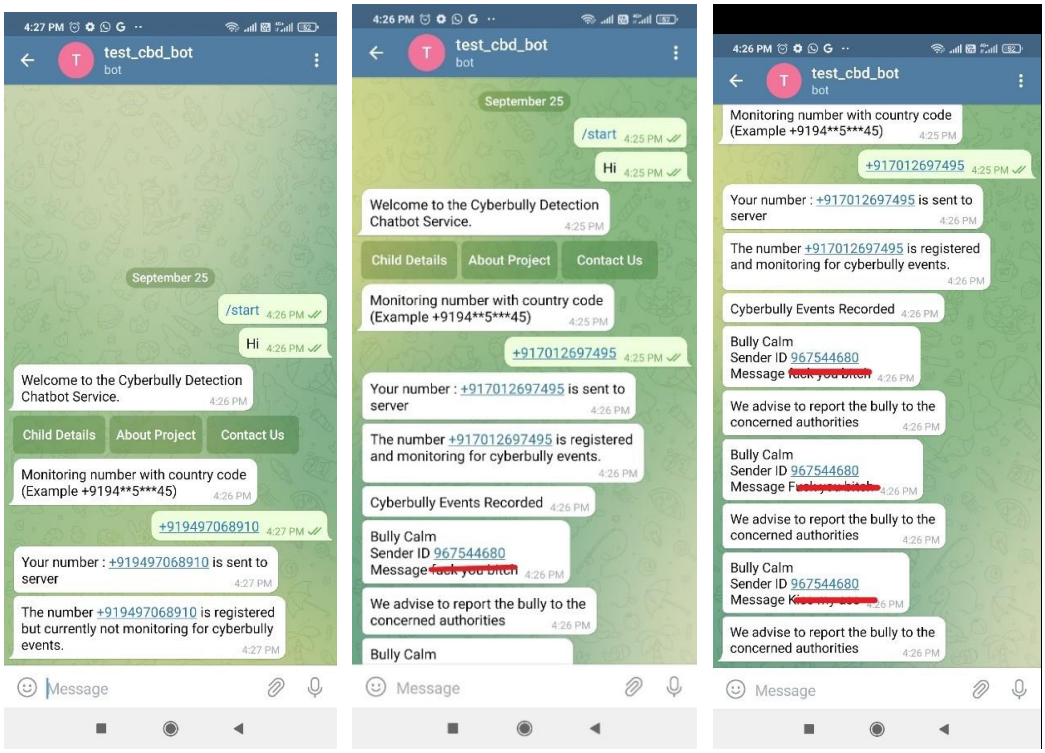

Figure 8: Sample Outputs of Chatbots

V. CONCLUSION AND FUTURE WORK

Due to the lack of efficient monitoring systems in the digital technology world, cyberbullying events are increasing exponentially. Cyberbullying events needs to be identified and alerted to the victim to safe their social life. In this paper, a chat bot is developed to human interaction and a deep learning model to detect cyberbullying models autonomously. The data used to train the model is obtained from GitHub and Kaggle and tested with Telegram real time data. The Hybrid Deep Learning Long Short-term Memory (LSTM) and Convolutional Neural Network (CNN) models are used and fused with Keras Functional API. Detection results shows 85% accuracy in text and 86% accuracy in image. The detected bully message is recorded into a cloud database and retrieved through chatbot and other applications. Text is extracted from images of typed, handwritten or printed text. The multi-language, cross language and mix languages are also considered. The functionalities can be improved to the chatbot for flexible interaction.

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