

Research Paper

AI-Based Approaches for Detection and Prevention of Domestic Violence

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Abstract—This study examines the role of artificial intelligence in identifying and predicting the risk factors associated with domestic violence across different cultural contexts. Domestic violence is a serious global problem that affects individuals physically, mentally, and socially, with women being the most vulnerable, although men are also impacted. Existing methods for detection and prevention are often reactive and limited in effectiveness, highlighting the need for more advanced approaches. With recent progress in AI technologies such as machine learning, deep learning, and natural language processing, it has become possible to analyze patterns of abuse and predict potential risks more accurately. These techniques can support early intervention and help provide timely assistance to victims. However, the use of AI in this area also raises important concerns related to privacy, data bias, and ethical responsibility. Additionally, cultural values, legal frameworks, and social conditions play a major role in both the occurrence of domestic violence and the effectiveness of AI-based solutions. This study stresses the importance of developing fair, transparent, and culturally sensitive systems, along with improving data diversity and integrating AI with social and public health services.

Keywords—Domestic Violence Detection, Artificial Intelligence, Machine Learning, Deep Learning, Natural Language Processing, Predictive Analytics, Risk Assessment, Early Intervention, Ethical AI, Data Privacy, Cultural Context, Social Support Systems.

I. INTRODUCTION

Domestic violence is a major social issue that affects individuals and families across the world,

causing physical, emotional, and psychological harm. It is a widespread problem that continues to impact people regardless of age, culture, or economic status. Studies have shown that women are more frequently affected, although men can also be victims in certain situations [1]. The effects of domestic violence extend beyond individuals and influence families and communities as well. Many cases remain unreported due to fear, social stigma, or lack of proper support systems [3]. In recent years, global events such as the COVID-19 pandemic have further increased the prevalence and severity of domestic violence, highlighting the urgent need for better detection and prevention strategies [7]. These challenges make it necessary to explore more advanced and proactive solutions.

With the advancement of technology, artificial intelligence has emerged as a promising tool for addressing complex social issues like domestic violence. AI techniques such as machine learning, deep learning, and natural language processing can analyze large volumes of data to identify patterns and predict risks [15]. These technologies enable systems to detect early warning signs of abuse and support timely intervention. AI-based solutions can also assist in analyzing communication data, behavioral patterns, and historical records to improve prediction accuracy [12]. Furthermore, recent innovations in technology-driven solutions have demonstrated the potential of AI in enhancing safety and prevention mechanisms [9]. This shift toward predictive analysis provides an opportunity to move from reactive responses to proactive prevention strategies.

Despite the benefits, the use of AI in domestic violence detection presents several challenges that must be carefully addressed. One of the major concerns is maintaining data privacy, as sensitive personal information is involved in such systems [10]. There is also a risk of bias in AI models if the

data used for training is not diverse or representative of different populations. Ethical issues related to fairness, transparency, and accountability must be considered to ensure responsible use of technology [35]. Additionally, the misuse of AI tools could create further risks instead of providing protection. Addressing these challenges requires collaboration between researchers, policymakers, and social experts to develop systems that are both effective and ethically sound.

Cultural and social factors play a crucial role in shaping the nature of domestic violence and its detection. Different societies have unique beliefs, norms, and legal frameworks that influence how domestic violence is perceived and handled [6]. What may be considered abuse in one culture may not be recognized in another, making it difficult to design a universal solution. Research has shown that attitudes toward domestic violence vary significantly across countries, which affects reporting and intervention efforts [5]. Therefore, AI-based systems must be designed with cultural awareness and adaptability to ensure accurate and meaningful outcomes. Incorporating diverse datasets and region-specific knowledge can improve the effectiveness of these systems.

Overall, the integration of artificial intelligence into domestic violence prevention offers significant potential for improving early detection and support systems. By combining advanced technology with social awareness, it is possible to develop systems that can identify risks and assist victims more effectively. Future research should focus on developing transparent and inclusive AI models that reduce bias and improve reliability [25]. It is also important to integrate AI solutions with healthcare, legal, and social service systems to create a comprehensive support network [36]. With continuous improvement and responsible implementation, AI can play a key role in reducing domestic violence and building safer communities worldwide.

II. LITERATURE SURVEY

Rao et al., [2024] [1] conducted a population-based study to examine the prevalence and risk factors of domestic violence among women in rural areas. Their research highlighted that domestic violence remains a significant issue, especially in less developed regions where awareness and support systems are limited. The authors identified key contributing factors such as economic dependency, lack of education, and social norms that discourage reporting abuse. The study emphasized that many victims do not seek help due to fear, stigma, or lack of resources. It also pointed out the importance of

community-level interventions and awareness programs in reducing such incidents. The findings suggest that improving education and providing social support can play a major role in preventing domestic violence. This work is important as it provides real-world insights into the causes of domestic violence and helps in designing effective prevention strategies.

Thiel et al., [2022] [7] analysed changes in domestic violence cases during the COVID-19 pandemic through a systematic review. Their study revealed that the pandemic led to a noticeable increase in both the frequency and severity of domestic violence incidents. Factors such as lockdown restrictions, financial stress, and limited access to support services contributed to this rise. The authors highlighted that victims were often trapped in unsafe environments with reduced opportunities to seek help. The study also emphasized the need for better crisis response systems and support mechanisms during emergencies. It suggested that digital platforms and remote support services can play an important role in assisting victims when physical access is restricted. This research provides valuable insights into how external conditions can influence domestic violence trends and highlights the importance of preparedness in handling such situations.

Kouzani et al., [2023] [9] explored the role of technological innovations in addressing domestic violence. Their work focused on how modern technologies, including artificial intelligence and smart systems, can be used to detect and prevent abuse. The authors discussed various tools such as mobile applications, monitoring systems, and predictive models that can help identify early warning signs of violence. They emphasized that technology can support victims by providing timely alerts and connecting them with support services. The study also highlighted the importance of integrating these technologies with existing social and legal systems to improve their effectiveness. While the research showed promising results, it also noted challenges related to privacy and ethical concerns. Overall, this work demonstrates how technological advancements can be used to create safer environments and improve prevention strategies.

Novitzky et al., [2022] [10] conducted a systematic review of the ethical challenges associated with using artificial intelligence in addressing domestic violence. Their study highlighted important concerns such as data privacy, bias in algorithms, and the risk of misuse of sensitive information. The authors explained that AI systems must be carefully designed to ensure fairness and transparency, especially when dealing with vulnerable

individuals. They also discussed the importance of obtaining consent and protecting user data while developing AI-based solutions. The study emphasized that ethical considerations should be a priority when implementing technology in sensitive areas like domestic violence detection. It also suggested that collaboration between researchers, policymakers, and social organizations is necessary to create responsible AI systems. This work is significant as it provides guidance on how to balance innovation with ethical responsibility.

Hui et al., [2022] [15] reviewed the use of machine learning techniques in addressing domestic violence. Their study focused on how data-driven approaches can be used to identify patterns and predict potential risks of abuse. The authors explained that machine learning models can analyze large datasets, including behavioral and communication data, to detect early warning signs. They highlighted that such systems can support timely intervention and improve decision-making for support services. The study also discussed challenges such as data quality, bias, and the need for diverse datasets to ensure accurate predictions. The findings suggest that machine learning has strong potential in improving domestic violence prevention strategies. This work provides a foundation for developing intelligent systems that can assist in early detection and help protect vulnerable individuals.

III. DATASET DETAILS

The dataset used in this project mainly consists of social media text data, particularly tweets that reflect different human emotions. Each record in the dataset includes a piece of text along with an associated label indicating the type of emotion, such as negative, neutral, or positive. These labels help in understanding the emotional tone behind each message. The dataset may also include emoticons or symbols that further support emotion identification. This structured format makes it suitable for applying machine learning algorithms for classification tasks. By analysing such data, the system can identify patterns related to anger, stress, or harmful intent, which may be linked to domestic violence situations. In addition to text data, the project also considers visual inputs such as videos from CCTV or webcam sources. These inputs are used to detect physical actions and behaviour that may indicate violence. Together, both text and visual data provide a comprehensive foundation for building a system that can detect emotional and physical signs of domestic violence.

Before using the dataset for model training, several preprocessing steps are performed to improve its quality and usability. The text data is first cleaned

by removing unnecessary elements such as stop words, punctuation, and special characters. This helps in reducing noise and improving the clarity of the input data. After cleaning, the text is converted into numerical form using techniques like TF-IDF, which assigns importance to words based on their frequency. This conversion is necessary because machine learning models can only process numerical values. The dataset is then normalized to maintain consistency across all features. After preprocessing, the data is split into training and testing sets, where 80% is used for training the model and 20% for evaluation. This ensures that the model can be tested on new, unseen data. For video inputs, frames are analysed to detect actions or expressions related to violence. These preprocessing steps help improve the accuracy and reliability of the system.

IV. PROPOSED METHODOLOGY

The proposed system follows a systematic approach to detect and prevent domestic violence by analyzing both textual and visual data using artificial intelligence techniques. In the initial stage, the system collects data from social media platforms such as tweets, where each text is associated with an emotion label like positive, neutral, or negative. This data is carefully examined to understand emotional patterns that may indicate stress, anger, or harmful behavior. Preprocessing is then carried out to improve data quality by removing unwanted elements such as stop words, punctuation, and special characters. After cleaning, the text is converted into numerical form using methods like TF-IDF, which helps in representing words based on their importance. The dataset is then normalized and divided into training and testing sets, typically using an 80:20 ratio. This allows the model to learn patterns from the training data and evaluate its performance on unseen data. Additionally, video inputs from CCTV or webcam sources are prepared for further analysis of physical activities.

After preparing the data, various machine learning and deep learning algorithms are applied to classify emotions and detect possible violence. Models such as Naïve Bayes, Decision Tree, Random Forest, Support Vector Machine (SVM), Convolutional Neural Network (CNN), and Long Short-Term Memory (LSTM) are trained using the processed dataset. Each model is evaluated using performance metrics like accuracy, precision, recall, and confusion matrix to determine its effectiveness. The results of different algorithms are compared to identify the best-performing model. The system also supports real-time analysis, where new text inputs or live video streams can be processed

instantly. For example, the system can analyze facial expressions using a webcam or detect violent actions from CCTV footage. Based on the output, the system can generate alerts or warnings. This combined approach helps in early identification of risky situations and improves the overall effectiveness of domestic violence prevention.

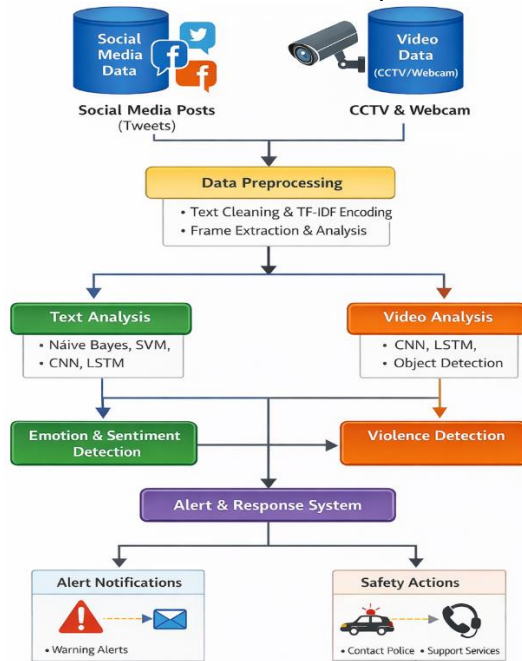


Figure [1]: AI-Based Domestic Violence Detection and Prevention System

Figure [1] presents the working flow of the proposed system for identifying domestic violence using artificial intelligence. The system takes input from social media text data and video sources such as CCTV or webcam. This data is first processed to make it suitable for analysis. After that, machine learning and deep learning models are applied to examine the data. The text analysis part focuses on detecting emotions, while the video analysis identifies any signs of violent activity. The results from both sections are then passed to an alert system. Based on the output, the system generates warnings and helps in taking quick safety actions when required.

V. RESULT AND DISCUSSION

The results of this project clearly show that the proposed system works effectively in detecting emotions and identifying possible domestic violence situations using both text and video data. After cleaning and preparing the dataset, it was divided into training and testing sets, and several models including Naïve Bayes, Decision Tree, Random Forest, SVM, CNN, and LSTM were applied. Among these, Decision Tree, Random Forest, and LSTM produced the best results with

very high accuracy. CNN also performed well, especially when handling both textual and visual inputs. The confusion matrix results indicate that most of the predictions were correct, with only a small number of errors. The system was also tested with new inputs such as live text and video, where it successfully identified emotional states and detected violent behavior. The comparison graphs further confirm that advanced models are better at understanding complex data patterns. Overall, the system is accurate, dependable, and useful for early detection and prevention of domestic violence.

CNN Accuracy : 99.0
 CNN Precision : 99.07407407407408
 CNN Recall : 98.66666666666667
 CNN FScore : 98.85024432308134

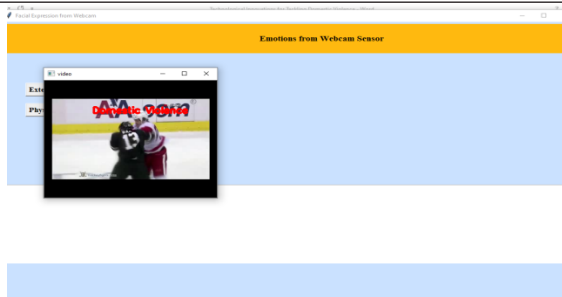
Figure [2]: Model Evaluation of Proposed System

Figure [2] shows the performance of the CNN model using metrics such as accuracy, precision, recall, and F1-score. These values indicate how well the model classifies data and detects patterns. The high scores reflect good prediction performance and overall reliability of the system.

Comment = Ok first assessment of the kindle it fucking rocks 🍌 Predicted as ----> POSITIVE
 Comment = kerburbarry Youll love your kindle Ive had mine for a few months and never looked back The new big one is huge No need for remorse 🍌 Predicted as ----> POSITIVE
 Comment = mikerfish Fair enough But i have the kindle and I think its perfect 🍌 Predicted as ----> POSITIVE
 Comment = richardebaker no it is too big Im quite happy with the kindle 🍌 Predicted as ----> POSITIVE
 Comment = Fuck this economy I hate aig and their non loan given asses 🍌 Predicted as ----> NEGATIVE
 Comment = Jquery is my new best friend 🍌 Predicted as ----> POSITIVE
 Comment = Loves twitter 🍌 Predicted as ----> POSITIVE
 Comment = how can you not love Obama he makes jokes about himself 🍌 Predicted as ----> POSITIVE

Figure [3]: Real-Time Text Emotion Prediction Output

Figure [3] shows the output of the system where new text inputs are analyzed and classified into different emotion categories such as positive, negative, or neutral. The system processes each input text and displays the predicted result alongside it. This demonstrates the model's ability to perform real-time emotion detection and provide accurate predictions based on the given data.



Figure[4] :Image Comparison for Visual Feature Analysis

Figure [4] shows the system detecting violent activity from video input. The model analyzes the video frames and identifies abnormal or aggressive behavior, displaying the result as “Domestic Violence” on the screen. This demonstrates the system’s ability to monitor real-time video and detect potential violence accurately.

DISCUSSION

The outcomes of this project highlight the importance of choosing suitable machine learning and deep learning models for detecting domestic violence. Models like Decision Tree and Random Forest performed very well because they can handle complex data patterns efficiently. Deep learning models such as CNN and LSTM also showed strong performance, especially in analyzing text and visual data together. The preprocessing steps, including cleaning the text and converting it into numerical form, played a key role in improving the model’s accuracy. Splitting the dataset properly ensured that the models were tested on new data, making the evaluation reliable. Visualization tools like confusion matrices and performance graphs made it easier to understand how the models performed. Combining text and video analysis makes the system more practical and effective. Overall, the project shows that AI-based approaches can be very useful in detecting and preventing domestic violence at an early stage.

VI. CONCLUSION

This project demonstrates how machine learning and deep learning techniques can be used to detect emotions and identify possible domestic violence using both text and video data. The dataset was carefully prepared through steps like cleaning the text, converting it into numerical form using TF-IDF, and splitting it into training and testing sets. Several models such as Naïve Bayes, Decision Tree, Random Forest, SVM, CNN, and LSTM were trained and tested. Among these, Decision Tree, Random Forest, and LSTM gave the best

results with very high accuracy, while CNN also performed well, especially for handling both text and video inputs. The system was able to correctly classify emotions and detect violent actions with very few errors. Tools like confusion matrices and graphs helped in understanding how well the models performed. Overall, the system proves to be effective and reliable for early detection of domestic violence. This project shows that AI can be used to improve safety and awareness, and it also provides a strong base for future improvements and real-time applications.

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