

**VIVEKANAND EDUCATION SOCIETY'S
INSTITUTE OF TECHNOLOGY**

Department of Computer Engineering



Project Report on

**Nirbhay Naari - An Artificial Intelligence tool for
detection of crime against Women**

In partial fulfillment of the Fourth Year (Semester-VII), Bachelor of Engineering (B.E.) Degree in Computer Engineering at the University of Mumbai Academic Year 2021-2022

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(2021-22)

**VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF
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Department of Computer Engineering



CERTIFICATE

This is to certify that **Sakshee Sawant, Srishti Vazirani, Khushi Zawar and Divya Raisinghani** of Fourth Year Computer Engineering studying under the University of Mumbai has satisfactorily presented the project on "**Nirbhay Naari - Tech to Combat Domestic Violence and Harassment at Workplace**" as a part of the coursework off PROJECT-II for Semester-VIII under the guidance of **Prof. Dr Nupur Giri** in the year 2021-2022.

This thesis/dissertation/project report entitled **Nirbhay Naari - An Artificial Intelligence tool for detection of crime against Women** by **Sakshee Sawant, Divya Raisinghani, Srishti Vazirani and Khushi Zawar** is approved for the degree of **Bachelor of Engineering in Computer Engineering**.

Programme Outcomes	Grade
PO1,PO2,PO3,PO4,PO5,PO6,PO7, PO8, PO9, PO10, PO11, PO12 PSO1, PSO2	

Date:

Project Guide:

Project Report Approval

For

B. E (Computer Engineering)

This thesis/dissertation/project report entitled ***Nirbhay Naari - An Artificial Intelligence tool for detection of crime against Women*** by ***Sakshee Sawant, Divya Raisinghani, Srishti Vazirani and Khushi Zawar*** is approved for the degree of ***Bachelor of Engineering in Computer Engineering.***

Internal Examiner

External Examiner

Head of the Department

Principal

Date: 31st March, 2022
Place: Mumbai

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.



Sakshi Sawant - 51



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We wish to express our profound thanks to all those who helped us in gathering information about the project. Our families too have provided moral support and encouragement several times.

Computer Engineering Department

COURSE OUTCOMES FOR B.E PROJECT

Learners will be to:-

Course Outcome	Description of the Course Outcome
CO 1	Able to apply the relevant engineering concepts, knowledge and skills towards the project.
CO2	Able to identify, formulate and interpret the various relevant research papers and to determine the problem.
CO 3	Able to apply the engineering concepts towards designing solutions for the problem.
CO 4	Able to interpret the data and datasets to be utilized.
CO 5	Able to create, select and apply appropriate technologies, techniques, resources and tools for the project.
CO 6	Able to apply ethical, professional policies and principles towards societal, environmental, safety and cultural benefit.
CO 7	Able to function effectively as an individual, and as a member of a team, allocating roles with clear lines of responsibility and accountability.
CO 8	Able to write effective reports, design documents and make effective presentations.
CO 9	Able to apply engineering and management principles to the project as a team member.
CO 10	Able to apply the project domain knowledge to sharpen one's competency.
CO 11	Able to develop professional, presentational, balanced and structured approach towards project development.
CO 12	Able to adopt skills, languages, environment and platforms for creating innovative solutions for the project.

ABSTRACT

To curb the domestic violence and violence against women happening at workplaces, Nirbhay Naari attempts to detect violence against women where CCTV cameras are installed. With the video footage and machine learning techniques, the project's goal is to capture the violence against women and spread the alert. Predominantly our project provides a platform for women to stand against domestic violence, continuous real-time monitoring of workplaces to keep a check on any kind of violence, and also detecting hand gestures through which the women can ask for help anytime. If the help gesture or violent activity is identified the model detects and alerts the nearest police station coming under their region with the vision to provide immediate police assistance. It also acts as evidence that will support their complaints as the victims will provide the audio file. The final benchmark corpus will be made up of posts divided into the following categories: Awareness, Empathy, Fund Raising, Personal Story, and General. We need to construct domain-specific embeddings for feature extraction from DV-related online posts. The notion of embeddings is founded on the assumption of a semantic link between terms, i.e. the pair "assault" and "abuse" will have a closer distance in the vector space than the pair "love" and "abuse." Domestic violence is a type of abuse that includes physical, emotional, psychological, and financial exploitation. Abusive language can be detected using natural language processing (NLP).

Keywords: harassment, sexual violence, social media, hand gestures, real-time monitoring.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO THE PROJECT

The United Nations defines violence against women as "any act of gender-based violence that results in, or is likely to result in, physical, sexual, or mental harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or private, eve-teasing penalize is the life." [1]

Wells' organization found that 21 percent of full-time employed adults said they were victims of domestic violence and 74 percent of that group said they've been harassed at work [2]. Population-level surveys based on reports from survivors provide the most accurate estimates of the prevalence of intimate partner violence and sexual violence. A 2018 analysis of prevalence data from 2000-2018 across 161 countries and areas, conducted by WHO on behalf of the UN Interagency working group on violence against women, found that worldwide, nearly 1 in 3, or 30%, of women have been subjected to domestic violence by a partner [3]. About 1,300 deaths were attributed to domestic abuse as of 2003.

This violence leads to high social and economic costs for women, their families, and societies. Such violence can: i) Have fatal outcomes like homicide or suicide. ii) Lead to injuries, with 42% of women who experience intimate partner violence reporting an injury as a consequence of this violence [4] iii) Lead to unintended pregnancies, induced abortions, gynecological problems, and sexually transmitted infections, including HIV [5,6]. These forms of violence can lead to depression, post-traumatic stress and other anxiety disorders, sleep difficulties, eating disorders, and suicide attempts.[7]

In 2020, between March 25 and May 31, 1,477 complaints of domestic violence were made by women. This 68-day period recorded more complaints than those received between March and May in the previous 10 years [8]. Globally, one in three women has experienced physical and/or sexual violence. Violence against women remains a major threat to public health and women's health during emergencies [9]. There is growing evidence on what works to prevent violence against women, based on well-designed evaluations. In 2019, WHO and UN Women with endorsement from 12 other UN and bilateral agencies published RESPECT women – a framework for preventing violence against women aimed at policymakers [10].

Due to lack of awareness i) as discussed above, reduces the productivity of the employees and negatively affects their performance[11] ii) Domestic violence can also impact a victim's ability to get to work (eg, through physical restraint)[12] lead to time off, and, ultimately, job loss for 5% to 27% of victims[13] iii) women with a history of DV tend to have a more disrupted work history, are consequently on lower personal incomes iv) it is also noticed that they have had to change jobs more often.

Nirbhay Naari is an AI-based help portal that will serve as

- i) a platform for women to oppose domestic violence
- ii) continuous real-time monitoring of the workplace to verify any type of violence present ,
- iii) evidence to support their complaints. It will capture CCTV videos of the public and workplaces, verify any violence that occurs, and spread alerts, allows women to seek help through gestures, conducts surveys, and provides questionnaires to predict women who are victims of domestic violence.

1.2 MOTIVATION

The motivation behind this project is primarily the surge in the rate of domestic violence during the lockdown. People have been neglecting this social issue for a long time. We hear such news all the time. So we decided to develop something which can contribute to society and help to reduce this social issue. Women need to be aware of the laws and help that is provided to victims of domestic violence so that they can get motivated to stand for themselves against Domestic Violence.

Domestic abuse has enormous social and economic costs, with repercussions across society. Isolation, inability to work, wage loss, lack of involvement in regular activities, and restricted capacity to care for themselves and their children are all possible outcomes for women. Still, 65 percent of companies don't have an official workplace domestic violence prevention policy, according to research conducted by the Society for Human Resource Management (SHRM). A 2013 survey found that only 20 percent offer training on domestic violence. A KPMG study for Vodafone in nine of their markets (2019) indicated that: If the productivity of domestic violence and abuse victims were 1% lower, the value of lost economic output would be \$0.9bn per year. If productivity were 5% lower, the value of lost economic output would be \$4.3bn per year. If productivity were 10% lower, the value of lost economic output would be \$8.6bn per year. Due to lack of awareness, this issue reduces the productivity of the employees and negatively affects their performance. Domestic violence can also impact a victim's ability to get to work (eg, through physical restraint) leading to time off, and, ultimately, job loss for 5% to 27% of victims.

1.3 PROBLEM DEFINITION

“Nirbhay Naari” aims to make “नारी निर्भय” and is a model that promotes and generates awareness about women's safety, while focusing on eradicating crime against women. According to the National Crime Research Bureau's (NCRB) Crime in India Report 2018, a crime against women occurs every 1.7 minutes in India, and a woman is subjected to domestic abuse every 4.4 minutes. In 2018, an estimated one in seven women had experienced physical and/or sexual violence from an intimate partner or husband in the past 12 months (13 per cent of women aged 15 to 49). According to the study, it also ranked first in the areas of violence against women. As per the data, 89,097 cases related to crimes against women were registered across India in 2018, higher than the 86,001 cases registered in 2017. “Nirbhay Naari” project provides a real-time monitoring function to check on violence using CCTV cameras in order to reduce misdeeds against women. Our solution identifies physical, sexual, psychological and verbal acts of abuse/violence against women and takes the imperative actions. This solution also gives a forum for women to speak out against abuse while also seeking assistance. Our model is trained in such a way that it will immediately send out an alert if any suspicious act of harassment against women is identified. Domestic Violence hand signals can be used to alert our model as a “Signal of help” and immediately police assistance can be provided.

This hand signal can be used even in the case of eve-teasing when a woman feels threatened to alert the police and penalize the culprits. Furthermore, using appropriately trained ML models, our project aims to forecast women who are susceptible to sexual violence. If a woman is suspects of being in a toxic relationship but is not able to identify or is facing abuse in the family and is unaware of how to face the situation, she can take up the questionnaire on the “Nirbhay Naari” portal. The questionnaire helps identify cases of abuse with the help of NLP and ML and depending on the level of severity and type of violence connects to appropriate consultation or even police help. With the motive to identify the abuser, the portal also has a section where audio/video recordings of complaints can be submitted, and the model has identified the crime can urgently report genuine cases to the police. All of this would be accomplished with the help of a collection of algorithms, all with the same goal in mind: WE WANT YOU TO BE NIRBHAY!

1.4 EXISTING SYSTEMS

1) SHEROES

Sairee Chahal developed SHEROES, a women-only community that offers a safe and trusting area. Women can talk about many elements of their lives here, such as health, careers, and relationships, as well as share their life stories, accomplishments, and memorable moments. It gives women a place to talk about their experiences. It also assists them with counseling hotlines and professional referrals. [20]

2) INTERNAL COMPLAINTS COMMITTEE(ICC) - WOMEN.

On the 24th of July, 2017, a new online complaint handling system was launched by the “Ministry of Women and Child Development”, an electronic box, for reporting complaints about inappropriate behavior at work. The She-Box is a platform for women working in or visiting any Central Government office to register sexual harassment at work complaints under the “Sexual Harassment of Women at Work Act, 2013”. When a complaint is made to She-Box, it is referred to the relevant entity's Internal Complaint Committee (ICC) for investigation. [21]

3) GOVERNMENT LAWS

The laws under Section 354 state that: Any man commits assault or use of criminal force to woman with intent to outrage her modesty or knowing it to be likely that he will thereby outrage her modesty, shall be punished with imprisonment or fined or both. The law protects against

- A) Sexual harassment
- B) Using assault or criminal force on a woman with intent to disrobe her
- C) Voyeurism
- D) Stalking

Sexual harassment is considered a violation of a woman's fundamental right to equality, which right is guaranteed by Articles 14 and 15 of the Constitution

Similarly, the laws under Section 509 declares that: uttering any word or making any gesture intended to insult the modesty of a woman will lead to imprisonment for three years and a fine.

1.5 LACUNA IN THE EXISTING SYSTEMS

1. There is no pre-existing system that checks violence against women only in real-time.
2. Although there are government laws that ensure severe punishment to the abusers after the occurrence of crime, no such system keeps check on the abusers.
3. Lack of awareness among women concerning their rights and laws.
4. No system that confirms that the women are suffering from violence through their stories.

1.6 RELEVANCE OF THE PROJECT

“Violence of any kind is a burden on many areas of the social system and has a subtle but significant impact on a country's development. In terms of law enforcement, health care, lost labor, and overall development, batterers cost countries a fortune. These expenses do not only harm the current generation; what starts as an assault on one person reverberates through the family and community for generations to come.” Crime against women is a long-standing problem.[14]

Women have long been seen as weak, defenseless, and easily manipulated. Women have long been thought to be the victims of violence. Although cultural conventions, religious traditions, economic and political situations may all have a part in the commencement and continuation of domestic abuse, it is ultimately a human decision. Women in patriarchal societies with strict gender norms are generally not prepared to defend themselves if their partners become abusive. Even so, part of the discrepancy stems from how men's reliance and fearfulness contribute to cultural disarming. Husbands who hit their spouses often believe they are exercising a right by keeping the household in order and punishing their wives' misbehavior, particularly their failure to keep their appropriate place.[15,16]

As per the latest “National Family Health Survey (NFHS) 2015-16, 29.5% of women have experienced physical violence since age 15”. Furthermore, according to the most recent National Crime Records Bureau (NCRB) report, released on September 29th, 2020 (The WIRE), an average of 87 rape cases were registered daily in India”.[17]

The novelty of our proposal is

1. Violence detection training model based on a new well-balanced big data set with various videos, and
2. More classes to identify the violent action itself rather than only the presence or lack of violence.

Thus, it is the need of the hour to make a portal where women can freely express themselves as well as seek help against any kind of violence.

CHAPTER 2

LITERATURE SURVEY

2.1 RESEARCH PAPERS REFERRED

[1] HEJASE, HUSSIN JOSE. “SEXUAL HARASSMENT IN THE WORKPLACE: AN EXPLORATORY STUDY FROM LEBANON.” JOURNAL OF MANAGEMENT RESEARCH 7.1 (2014): 107. WEB.

This research examines workplace sexual harassment in several Lebanese enterprises. To that end, a questionnaire has been created and distributed. One hotel, various eateries and pubs, and a university were among the entities contacted. The high response rate- 67% allowed for the creation of a comprehensive and trustworthy information resource, which should allow for application in terms of on-the-ground experience, awareness, and action in the indicated locations. The establishment of plans and the promotion of awareness, based on the results of this research, is the intended outcome of this work. The findings are also intended to help define future research projects.

[2] “DOMESTIC VIOLENCE SCREENING AND REFERRAL CAN BE EFFECTIVE, PRESENTED AT THE NATIONAL CONFERENCE ON HEALTH CARE AND INTIMATE PARTNER VIOLENCE, SAN FRANCISCO, CA, OCTOBER 2000.”

In this work, we investigate a targeted intervention strategy for IPV victims (aged 18 to 65 years) in the emergency room that allows treatment from a professional manager. The main goal was to figure out if there was a link between increasing screening rates and greater detection of violence. Once the victim was identified through screening or self-revelation, the nurse notifies a volunteer advocate from a neighboring human care agency. The client received telephone-based therapy from an IPV case manager in the third phase to assist her to avoid further violence.

[3] DI FRANCO, M., MARTINES, G. F., CARPINTERI, G., TROVATO, G., & CATALANO, D. (2020). DOMESTIC VIOLENCE DETECTION AMID THE COVID-19 PANDEMIC: THE VALUE OF THE WHO QUESTIONNAIRE IN EMERGENCY MEDICINE.

The focus of this research is to see the incidences of domestic violence cases among admissions to a large Italian hospital's emergency room in 2020, including during the whole "Lockdown". It also focuses on documenting the acute and long-term health effects of violence, as well as evaluating the WHO screening as a tool for finding instances that might otherwise go unnoticed. For this, a database of each patient in the Emergency Room was created, and a self-managed questionnaire from the "WHO Multi-country Study on Women's Health and Domestic Violence against Women" was used in women referred to the ER, with a keyword- search such as "violence" or "trauma" to find the data and cases of violence.

[4] YUT-LIN W, OTHMAN S. EARLY DETECTION AND PREVENTION OF DOMESTIC VIOLENCE USING THE WOMEN ABUSE SCREENING TOOL (WAST) IN PRIMARY HEALTH CARE CLINICS IN MALAYSIA. ASIA PACIFIC JOURNAL OF PUBLIC HEALTH. 2008;20(2):102-116. DOI:10.1177/1010539507311899

This is research that looks at the relationship between adult patients' socioeconomic factors and domestic violence screening and further help-seeking behavior if they are assaulted. Using a structured questionnaire that included an adaptation of a "validated 8-item Women Abuse Screening Tool, the same was done (WAST)". The findings revealed that primary care can play a key role in recognizing domestic abuse by using the WAST screening instrument, or a suitable adaptation of it, with women patients during routine visits to various health clinics.

[5] PIN WANG, PENG WANG, EN FAN,VIOLENCE DETECTION AND FACE RECOGNITION BASED ON DEEP LEARNING,PATTERN RECOGNITION LETTERS,VOLUME 142, 2021, PAGES 20-24,ISSN 0167-8655,

This suggests the method employs artificial features and depth features to extract the video's spatiotemporal properties, which are then combined with the trajectory features using a convolutional neural network. The multi-foot input CNN model and the SPP-based CNN model are introduced in response to the problem that face images in surveillance video cannot be reliably recognised due to low resolution. The accuracy of the brute force identification approach suggested in this study was tested on the 'Crow and Hockey datasets', and it was shown to be as high as 92 percent and 97.6 percent, respectively. The violence detection method suggested in this research improves the accuracy of video violence detection, according to experimental data.

[6] SHARMA M., BAGHEL R. (2020) VIDEO SURVEILLANCE FOR VIOLENCE DETECTION USING DEEP LEARNING. IN: BORAH S., EMILIA BALAS V., POLKOWSKI Z. (EDS) ADVANCES IN DATA SCIENCE AND MANAGEMENT. LECTURE NOTES ON DATA ENGINEERING AND COMMUNICATIONS TECHNOLOGIES, VOL 37. SPRINGER, SINGAPORE.

This paper proposes architecture that extracts features from video frames using a pre-trained “ResNet-50 model”, which is then fed into a “ConvLSTM block”. To eliminate occlusions and inconsistencies, short-term difference of video frames to provide additional robustness is used. “Convolutional neural networks allow us to extract more concentrated spatio-temporal data from frames, which helps LSTMs cope with the sequential nature of films”. The model takes raw movies as input, translates them to frames, and then generates a binary label of violence or non-violence. To remove extraneous details, we used cropping, dark-edge removal, and other data augmentation techniques to pre-process the video frames.

2.2 BOOKS/ JOURNALS/ARTICLES REFERRED

[1] GHOSH, BISWAJIT & CHOUDHURI, TANIMA. (2015). ‘NEW PROTECTION AGAINST DOMESTIC VIOLENCE IN INDIA’. INDIAN JOURNAL OF DEVELOPMENT RESEARCH AND SOCIAL ACTION.

The “Protection of Women from Domestic Violence Act of 2005 (PWDVA)” is an all-inclusive law that handles all household difficulties confronting women. The law divides “domestic violence” into four sections: “physical”, “sexual”, “verbal” and “emotional”, and “economic abuse”, with the objective of broadening the definition of domestic violence. The act creates severe criteria for prosecuting anyone who mistreats women in home situations. There are no bailable offenses under the “PWDVA”. The law empowers the court to prohibit the woman or her children from being subjected to any more acts of domestic violence

[2] TALBOYS, SHARON & KAUR, MANMEET & VANDERSLICE, JAMES & GREN, LISA & BHATTACHARYA, HAIMANTI & ALDER, STEPHEN. (2017). WHAT IS EVE TEASING? A MIXED METHODS STUDY OF SEXUAL HARASSMENT OF YOUNG WOMEN IN THE RURAL INDIAN CONTEXT. SAGE OPEN. 7. 215824401769716. 10.1177/2158244017697168.

Eve-teasing was identified as a severe community concern in this study, which used a community-based participatory approach with 9 villages in Punjab, India. The purpose of this study was to define eve-teasing in rural areas, particularly among female adolescents, and to devise a method for determining its prevalence. Direct observation of questionnaires, group discussions, and semi-structured interviews were used as part of a mixed technique study. The questionnaire provides a culturally relevant and age-appropriate way to measure the prevalence of eve-teasing among Indian female youth

2.3 PATENT SEARCH AND INFERENCE DRAWN

[1] AU2021101736A4 IS A METHOD FOR ANALYZING AND OPTIMIZING VIOLENCE AGAINST WOMEN ON SOCIAL NETWORKING SITES

The current invention provides a technique for evaluating and improving violence against women on social networking sites. This technique tries to conduct a theoretical investigation from the following perspectives: An overview of social networking sites and gender-based violence, including how women become victims of social networking sites, preventative steps to take, and a conclusion. 100> e-mailing a link and a letter with a series of questions to a group of responses in a certain location about 102 individual replies are collected by violence against women. It categorizes individual reactions into violent and non-violence and then categorizes the 106 violence responses into different kinds of violence. evaluating the violence to determine the probable causes of the violence educating internet users and making them aware of cyber regulations to reduce violence.

[2] AU2021101793A4 IS METHOD FOR ANALYZING AND OPTIMIZING VIOLENCE AGAINST WOMEN ON SOCIAL NETWORKING SITES

The current invention provides a technique for evaluating and improving violence against women on social networking sites. This technique tries to conduct a theoretical investigation from the following perspectives: An overview of social networking sites and gender-based violence, including how women become victims of social networking sites, preventative steps to take, and a conclusion. send a link and a letter with sets of questions to individuals through e-mail to a group of respondents in a region about 102 violence against women gather individual replies, dividing them into violent and non-violence responses, and then segregating them.

[3] US2014329491A1 PROTECTEM (DOMESTIC ABUSE AND EMERGENCY APP)

ProtectEM is a mobile application designed to help victims of domestic violence, rape, abduction, sexual assaults, and other forms of unprovoked violence by providing emergency (911) assistance. The app can be downloaded to any mobile device through regular app stores, or it can be embedded into wearable devices/accessories such as earrings, watches, necklaces, clothing, skin patches, or electronic tattoos, among other things, that can be easily activated in an emergency to alert emergency responders that the wearer is in danger and requires assistance. It would also broadcast the wearer's exact position so that first responders could arrive promptly.

2.4 COMPARISON OF EXISTING SYSTEMS

1. Comparing it with SHEROES, a women-only community that offers a safe and trusting area. Here, women can talk about many elements of their lives, such as health, careers, and relationships, as well as share their life stories whereas our system detects the violence in real-time and keeps check on the abusers.
2. Although there are existing laws in our country that help women to fight against any kind of violence many times women find these proceedings quite overwhelming and tend to get scared whereas our portal helps women to silently raise their voices against the violence and seek justice.
3. There also exists a chatbot RAINBOW where women can talk about their relationships that don't feel right and it then helps women to navigate through this phase. Our system has a similar portal where a woman can share her audio clips or record audio which can act as proof against violence along with connecting to various helplines near her area.

CHAPTER 3

REQUIREMENT GATHERING FOR PROPOSED SYSTEM

3.1 INTRODUCTION TO REQUIREMENT GATHERING

Requirements gathering is an exploratory process that involves researching and documenting the project's exact requirements from start to finish. Effective requirements gathering and requirements management start at the beginning of the project.

Requirement's elicitation (also known as Requirements Gathering or Capture) is the process of generating a list of requirements (functional, system, technical, etc.) from the various stakeholders (customers, users, vendors, IT staff, etc.) that will be used as the basis for the formal Requirements Definition.

3.2 FUNCTIONAL REQUIREMENTS

1. Real-time monitoring of CCTV footage.
2. Real-time analysis of audio, if present.
3. Detecting help gestures for women to seek help.
4. Calculating the confidence score.
5. Story summarization and prediction, further providing women with helpline numbers.

3.3. NON-FUNCTIONAL REQUIREMENTS

1. Predictions of the system should be accurate.
2. Efficient performance of the system
3. The system should be robust and it should continue to work efficiently despite any failure.
4. The system should provide utmost privacy and security to the user.
5. System should be scalable and overall flexible.

3.4. HARDWARE AND SOFTWARE REQUIREMENTS, TECHNOLOGY AND TOOLS USED

a. Hardware:

Graphics Processing Unit
High-Performance Computing

b. Language:

Python

c. IDE:

Jupyter Notebook

d. Modules/Packages:

1. Scikit learn
2. Numpy
3. Matplotlib
4. Pandas
5. Keras
6. TensorFlow

e. Framework:

1. Flask

f. Deployment:

1. Heroku

g. Cloud resources:

1. AWS

3.5. CONSTRAINTS OF WORKING

1. Noise while recording
2. Noise in the text
3. Language barrier
4. No readily available dataset
5. Not enough videos to cover the corner cases to detect abuse against women.

CHAPTER 4

PROPOSED DESIGN

4.1 BLOCK DIAGRAM OF THE PROPOSED SYSTEM

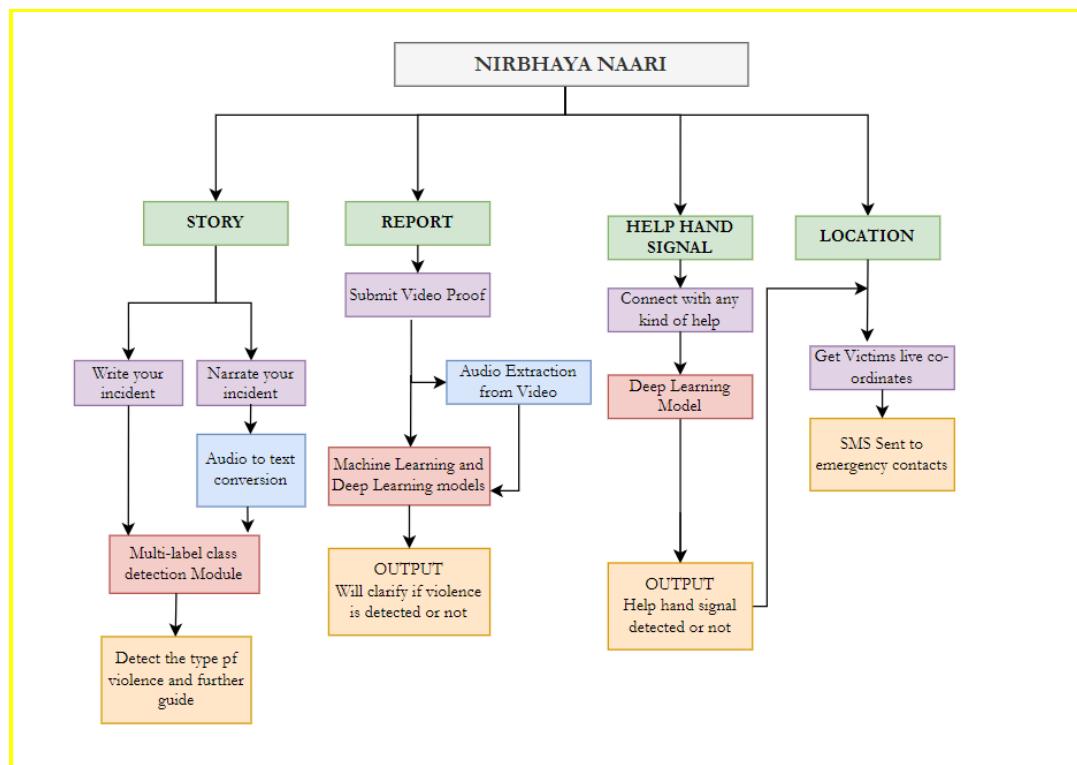


Fig.1. Block diagram of the project

As shown in figure 2 firstly, the victim will be able to use the violence help portal available to her by our system. The Violence/Harassment Story Summarization model would be trained using Twitter/Facebook API and Surveys. This model will utilize audio from the Nirbhay Naari portal to determine if the user is prone to violence or harassment. The CCTV video will be used as input for the Real-Time Crime Detection against women model. The three components of the system for detecting crimes against women will then function as follows:

- i) The video's Violence/Crime Scene Detection Module will detect any fights or physical abuse directed towards women. It will raise the value of the probability character if it is detected.

- ii) The presence of abusive language/help shouts in the CCTV video will be detected by audio detection of Verbal Harassment or Verbal Help. It will raise the value of the likelihood character if it is detected.
- iii) The Help Hand Signal Detection module will identify the existence of help hand signals.
- iv) Profiling for all three modules will be done and will be stored in a cloud database.

4.2 MODULAR DIAGRAM

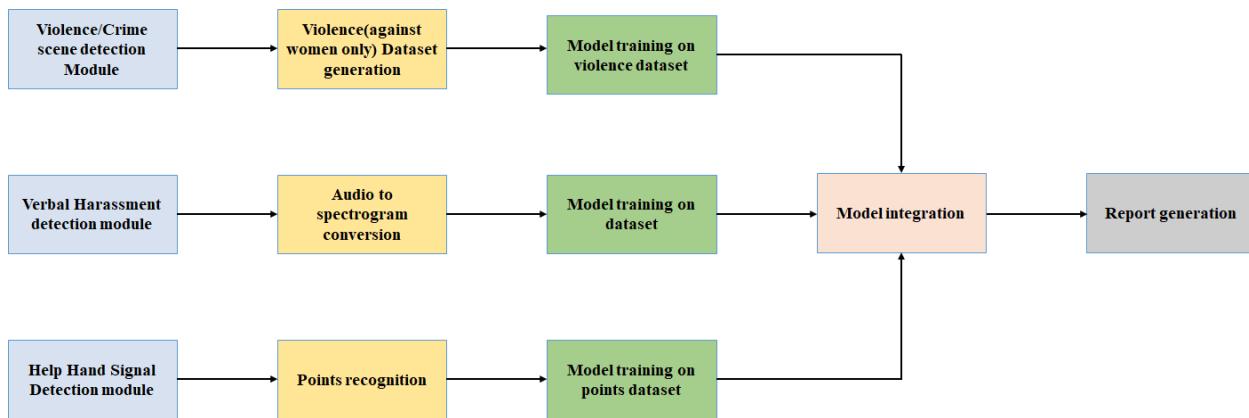


Fig.2. Modular diagram of the project

As the algorithm's last phase, we'll ensemble all three modules into one as three threads and will proceed for probability character calculation. A profiling cloud database is also generated in the backend simultaneously.

The portal, which is the next main goal of our work, is a platform where women may submit their tales, and the model summarizes them as critical or uncritical. For this, data from the Facebook/Twitter API will be categorized as "critical" or "uncritical" using NLP to build a standard data set for training the Deep Neural Network model for summarizing women's experiences and identifying victims of abuse. The essential tales would be saved in a cloud-based profile database.

4.3 DETAILED DESIGN OF THE PROPOSED SYSTEM

a. Data flow diagram:



Fig.3. DFD Level 0

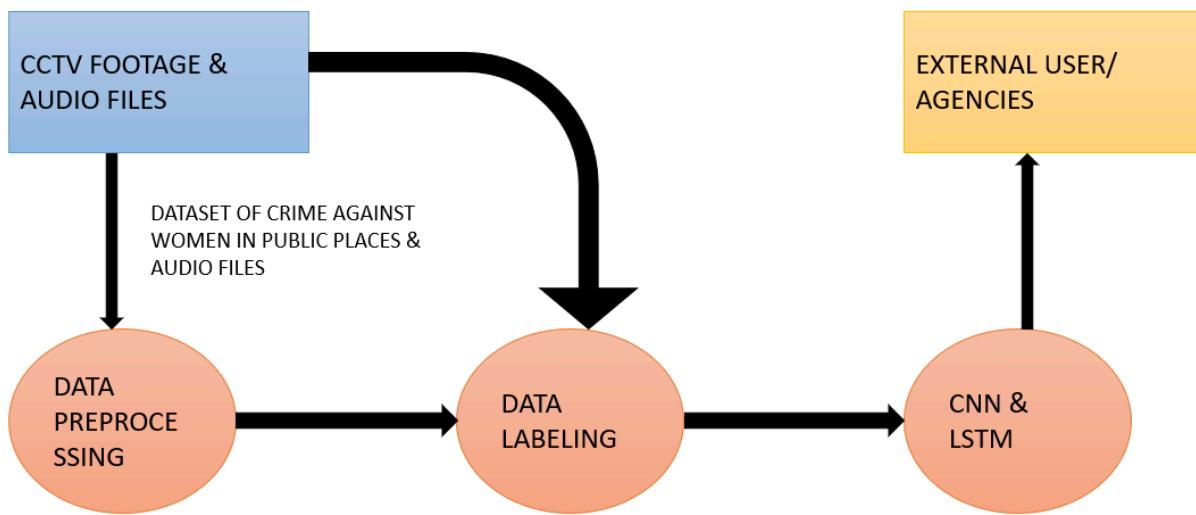


Fig.4. DFD Level 1

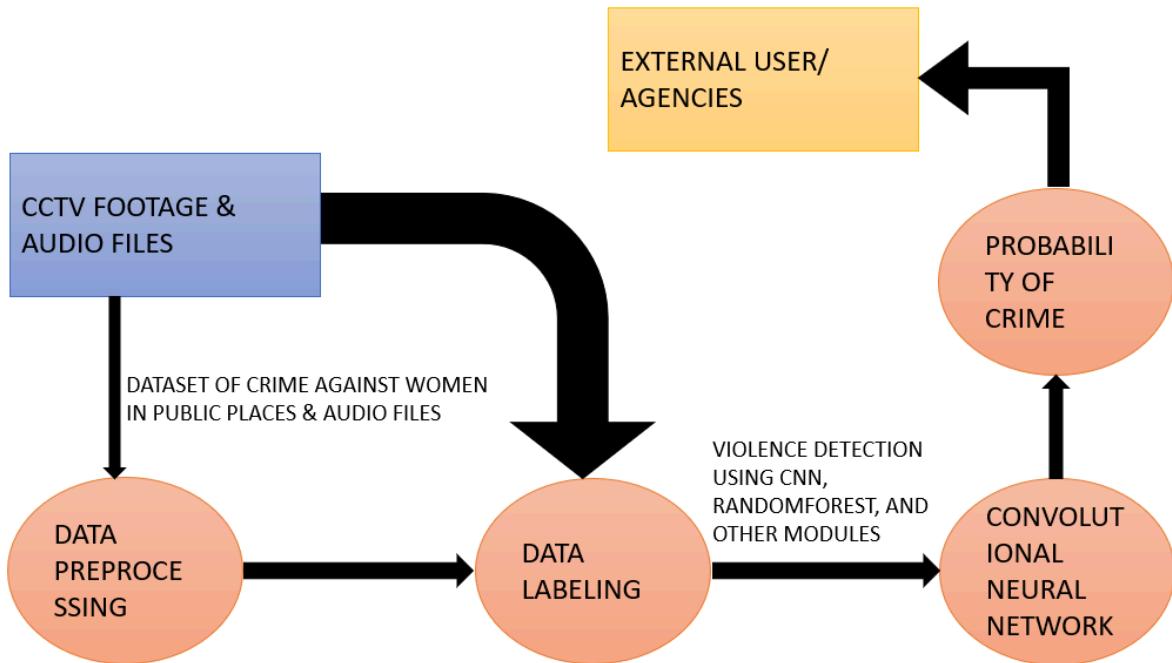


Fig.5. DFD Level 2

Explanation of DFD diagram:-

- Data in the form of cctv footage is transferred to the servers.
- This data is passed in our convolutional neural network.
- This CNN is trained on dataset gathered from various sources on the internet.
- Finally we get the output data i.e. the data predicting whether violence against women is taking place or not.

b. Flowchart:

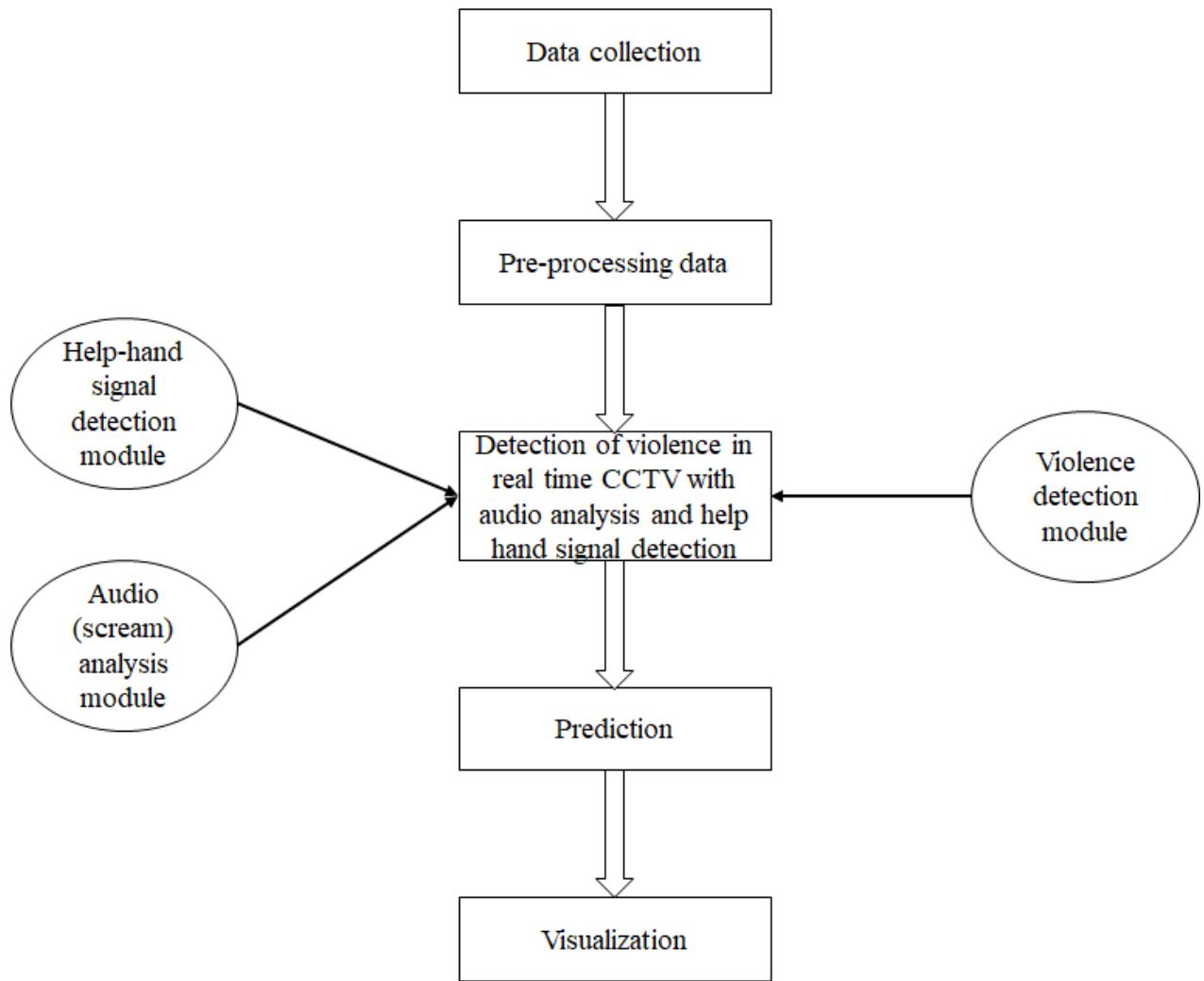


Fig.6. Flowchart

Explanation of flowchart:

1. Data Generation:

Three types of data are generated:

- a. Video dataset
- b. Audio dataset
- c. Image(hand signals) dataset

2. Pre-processing:

- a. Data augmentation using python libraries
- b. The image dataset is labeled using LabelImg.py

3. Violence Detection Module:

- a. We have chosen the Convolutional neural network as a spatial features extractor
- b. The extracted features are to be fed into LSTM Layer to learn the temporal relation

4. Audio Analysis Module:

- a. We first extract MFCCs from the data set using Librosa library
- b. Then we need to train the SVM model over those MFCCs and save the model using the Tensorflow library.

5. Help hand signal detection module:

- a. Detecting hand keypoints using Opencv
- b. Then use subsequent hand landmark model for training and detecting

6. Detection of Violence, Audio analysis and Help hand signal detection:

- a. All the three models are then integrated as three threads in a single model
- b. A character is incremented/decremented depending upon the three parameters
- c. Also, a profiling database is generated in the backend simultaneously

7. Prediction:

- a. If the value of the probability character crosses a threshold, violence against women is successfully detected
- b. The authorities are then alerted

8. Visualization:

- a. Continuous on-screen real-time visualizations are shown depending on the changing values of the various parameters
- b. Violence report, audio report and a Help signal detected report are generated and sent to the authorities along with the profiling database

c. State Transition Diagram

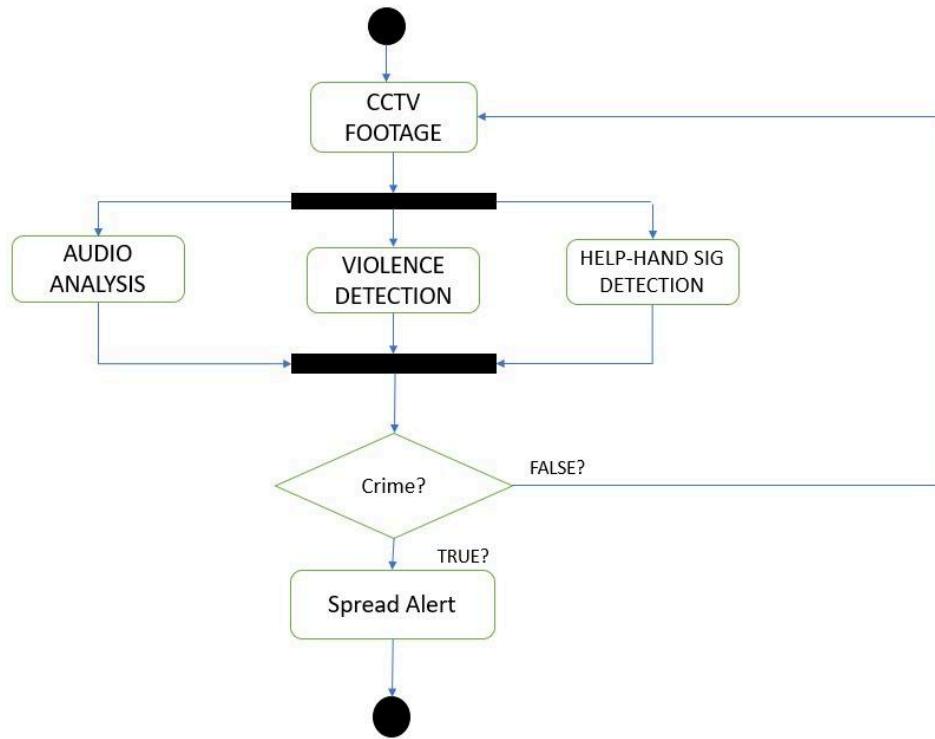


Fig.7. State Transition Diagram

Explanation of State transition diagram:

1. The system will be provided with CCTV footage and the audio files. The video will be divided into frames and MFCCs will be extracted from the audio dataset.
2. The violence detection module using CNN and LSTM will detect any sort of violence against women.
3. The detection of help hand signals, if any, will help to increase accuracy and decrease false alarm rate.
4. MFCCs are extracted from audio dataset using Librosa library. Then we train our SVM model and save the same using Tensorflow library.
5. The violence detection, audio classification module and help hand signal detection modules will then be integrated to detect violence. If violence against any women is detected then alert will be given to respected authority to avert the crime.

d. ER Diagram

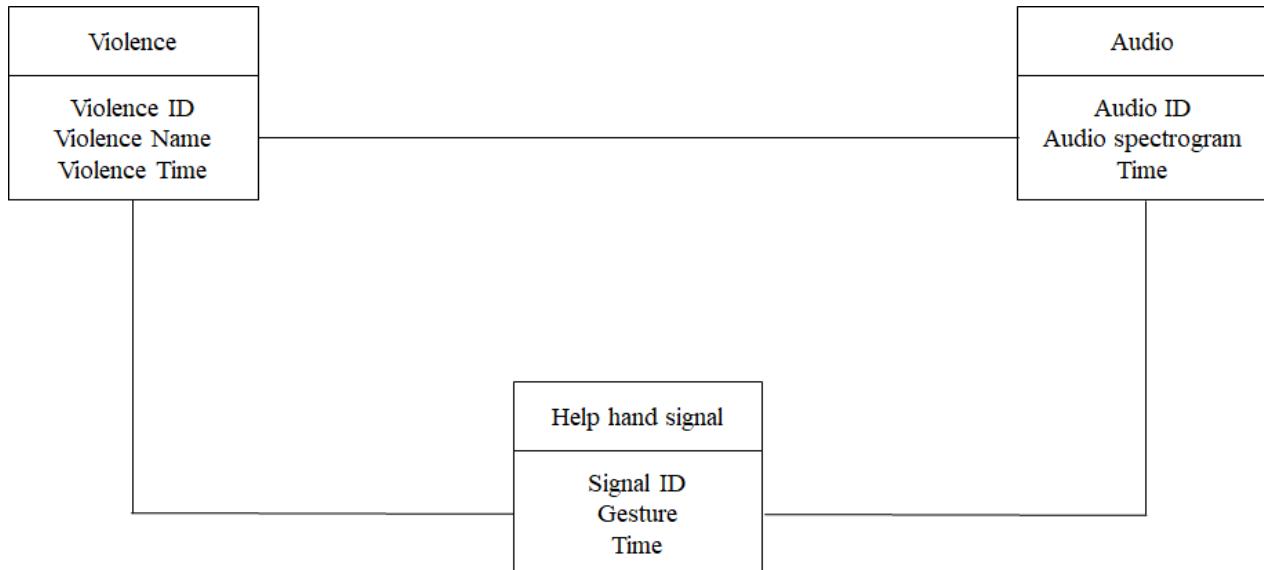


Fig.8. ER Diagram

1. Violence
 - a. A violence id will be generated in the backend
 - b. Kind of violence will be stored in the database
 - c. The time for the detection of a violent scene will be stored in the database
2. Audio:
 - a. An audio id will be generated in the backend
 - b. The generated Audio Spectrogram will be stored in the database
 - c. The time for the detection of a particular audio will be stored in the database
3. Help hand signal:
 - a. A signal id will be generated in the backend
 - b. Gesture category will be stored in the database
 - c. The time for the detection of a help signal will be stored in the database

4.4. PROJECT SCHEDULING & TRACKING USING TIMELINE / GANTT CHART

Year	1st Year											
	1	2	3	4	5	6	7	8	9	10	11	12
Activities / Months												
Research and Model Architecture study												
Collection and preprocessing of prototyping dataset												
Selection and training of the models for Violence detection and Verbal harassment.												
Conducting surveys from NGOs												
Building prototype software by Integration with AWS often-used												
Deployment and Testing												
Scaling of Framework												
Final Report												

Fig.9. Project Scheduling

CHAPTER 5

IMPLEMENTATION OF THE PROPOSED SYSTEM

5.1 METHODOLOGY EMPLOYED FOR THE DEVELOPMENT

The project intends to make a reliable, robust, and accurate model for detecting potential violent acts against women that can be used to govern women's safety. Two main components will help reach this aim.

- i)Real-time crime against women detection
- ii)Violence/Harassment Story Summarization Module

Research Plan

The research plan outlines a step-by-step procedure for implementing violence detection in surveillance scenes

1. Data Preprocessing:

We use web scraping to obtain over 100 video categories, half of which involve violent action scenarios against women in public areas, and the other half of which have non-violent scenes. We'll augment the RWF-2000 video-based database proposed by Duke Kunshan University's Speech and Multimodal Intelligent Information Processing Lab.

The accuracy of several types of data augmentation models will be compared, and we will use either Adversarial training or Generative adversarial networks to do so. Keras ImageDataGenerator, Skimage, or OpenCV Python libraries would be used for data augmentation in computer vision.

2. Data Modeling:

Identification of violence/crime scenes against women, audio-video conversion, and detection of verbal harassment or verbal help, as well as detection of aid hand signals, are the three main modules we propose. The probability value will be calculated using all three models. When the threshold value is exceeded, the authorities are notified automatically that a crime against women is taking place. Following the dataset production and augmentation of videos involving crime against women, the image dataset is created by dividing the videos into frames. The picture dataset is then labeled with LabelImg.py. On this dataset, we will train our CNN and LSTM models.[18]

We'll convert audio to spectrogram and audio to text to detect verbal harassment. We will train CNN and NLP models on the spectrogram and textual datasets, respectively.

For help hand signals, two datasets have been utilized. The 'Canadian Women's Foundation' created the Signal for Help, which was launched on April 14, 2020. After the Women's Funding Network (WFN) embraced it, it quickly expanded around the world. The signal is made by displaying the ASL characters A and B. To begin, the Kaggle ASL alphabet dataset was used for indication detection to assess the performance of more intricate data. The NUS hand posture dataset with the cluttered background was used to compare the results to earlier research and determine which had the highest recognition rate . For a deeper comprehension of the considered datasets, the figure exhibits examples from them, one with a plain background and the other with a cluttered background.

For multilabel classification of stories, we collected the suitable, curated, and most delinquent data from Facebook as the primary social media channel because of its widespread popularity and considerable interaction of sharers and supporters on Facebook groups. The entries were gathered from a variety of pages that examine various aspects of violence. The extraction technique employed the Facebook Graph API, and the search phrases were 'domestic violence' and 'sexual violence'. The manual classification of data extracted was done in order to create a benchmark. Because human annotation is a time-consuming process, we randomly choose 2,000 postings. We kept cases including hyperlinks or graphics out of the analysis. The total number of postings in the final benchmark corpus was 1064, divided into four categories: sexual violence, domestic violence, psychological violence, and fatalities. Given that no earlier study on multi-label violence identification has been done, the size of the acquired dataset is considered moderate.

- S1 post as Sexual violence: Women sharing personal experiences to educate other women
- S2 post as Domestic violence: Women sharing if they are facing/overcoming domestic abuse
- S3 post as Psychological violence: Financial crisis and verbal abuse taking a toll on mental health
- S4 post as Fatalities: Women sharing experiences where they have lost a loved one to abuse

As the algorithm's last phase, we'll ensemble all three modules into one as three threads and will proceed for probability character calculation. A profiling cloud database is also generated in the backend simultaneously.

For storing our audio and video files, we have used AWS. The audio and video files taken from our website are stored in S3 bucket of AWS and the URL of these files are stored in our PHP database. The portal, which is the next main goal of our work, is a platform where women may submit their tales, and the model summarizes them as critical or uncritical.

5.2 ALGORITHMS AND FLOWCHARTS FOR THE RESPECTIVE MODULES DEVELOPED

ALGORITHMS

- **Convolutional Neural Networks (CNN)** for video classification

The CNNs architecture to be used is described in great depth in [24]. The most informative n-gram features are to be retrieved and the embeddings for each word are to be stored in the model's first layer. It will next travel to the pooling layer, which generates feature vectors and converts the prior convolutional representation into a higher level of abstract perspective. Finally, the dense layer takes the output of the created feature vectors as input and creates a prediction for the post in question

- **Long Short-Term Memory (LSTM)** for video classification.

LSTM- Memory units, which preserve previous information throughout time, and non-linear gating units, which regulate information flow, are at the heart of LSTMs. The LSTM has three gates.[25]

GRU's- GRUs are essentially LSTMs with two gates added. The input and forget gates are combined into a single device called the update gate in GRUs. Thus, for text classification tasks, LSTMs and GRUs are considered the state-of-the-art semantic composition models, as they learn long-term connections between words in a sequence without storing redundant information.[26]

- **Support Vector Machine (SVM)** for audio classification

The objective of the support vector machine algorithm is to find a hyperplane in an N-dimensional space(N — the number of features) that distinctly classifies the data points. Hyperplanes are decision boundaries that help classify the data points. Data points falling on either side of the hyperplane can be attributed to different classes. The dimension of the hyperplane depends upon the number of features.[27]

- **Randomforest** for audio classification

Random forest is a supervised learning algorithm. The "forest" it builds is an ensemble of decision trees, usually trained with the “bagging” method. The general idea of the bagging method is that a combination of learning models increases the overall result. Random forest consists of a large number of individual decision trees that operate as an ensemble. Each individual tree in the random forest spits out a class prediction .The class with the most votes becomes our model's prediction.[28]

FLOWCHARTS:

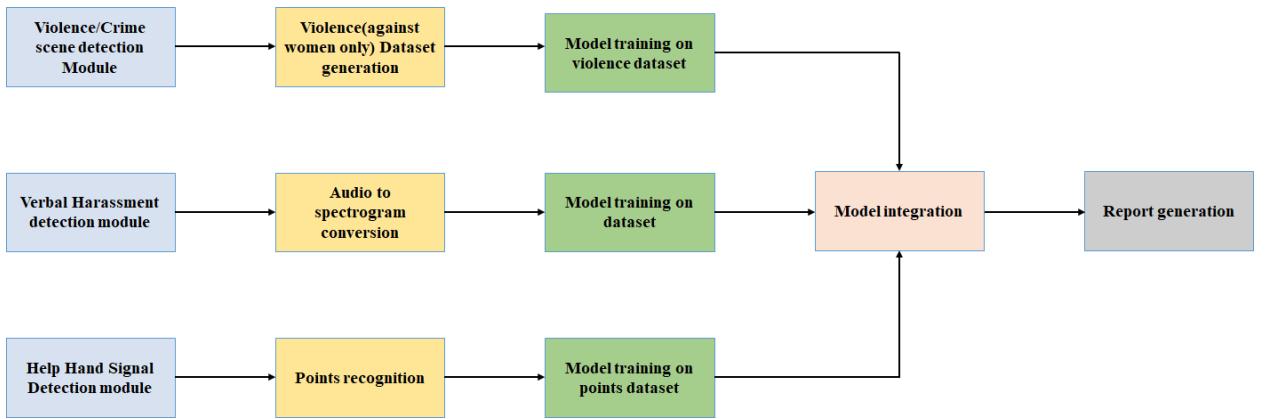


Fig.10. Flowchart showing working of different modules.

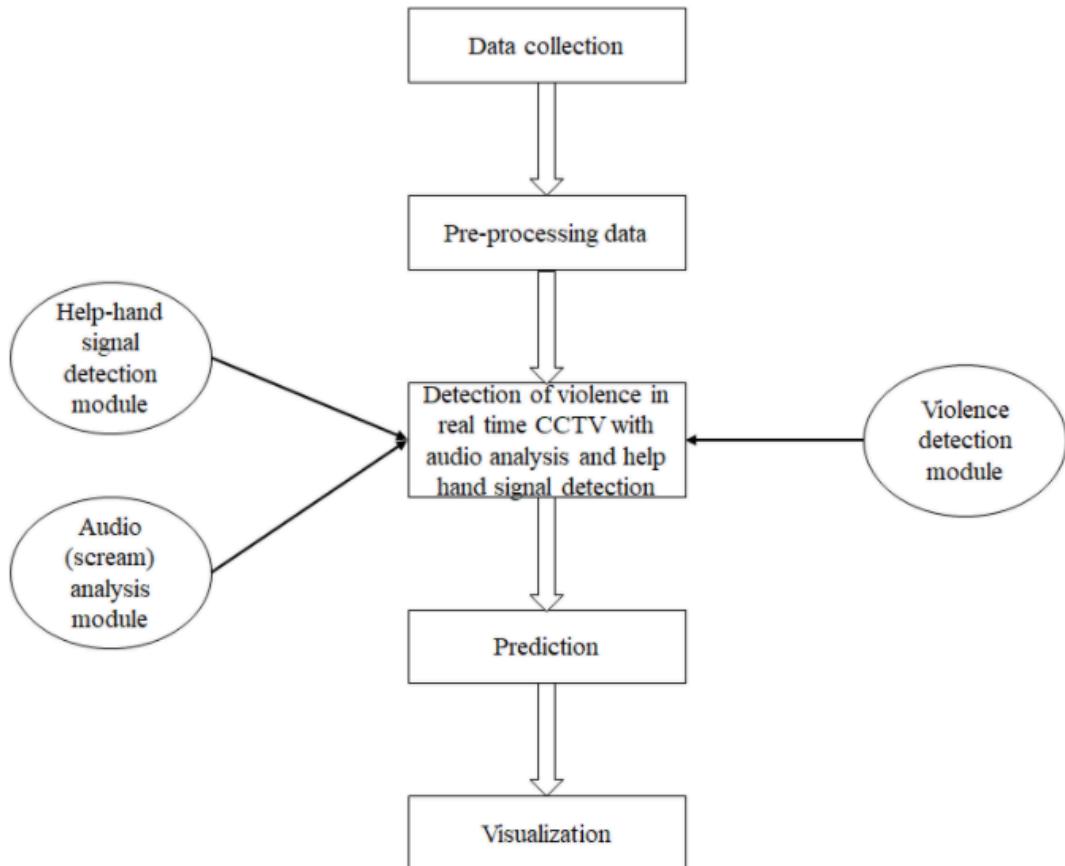


Fig.11. Flowchart showing the working of our system.

5.3 DATASET SOURCE AND UTILIZATION

Audio Detection of Harassment and Summarization

- 1) Audio Dataset is scraped from various websites like <https://www.freesoundeffects.com/>,
<https://zenodo.org/record/1188976>
- 2) Extracted posts from Twitter and Facebook using third party libraries like Tweepy and facebook-scraper along with their APIs. Later used this collected data to augment it to the offenseval 2019 English dataset.

Violence/Crime Scene Detection Module

Used web scraping to create our own youtube video dataset.

Drive link:

https://drive.google.com/drive/folders/1LJLhCdwJkzx8oC_ns4sDWUCRcP6YBLoD?usp=sharing

Help Hand Signal Detection

The Kaggle ASL alphabet dataset was used for indication detection to assess the performance of more intricate data. The NUS hand posture dataset with the cluttered background was used to compare the results to earlier research and determine which had the highest recognition rate.

CHAPTER 6

TESTING OF THE PROPOSED SYSTEM

6.1 INTRODUCTION TO TESTING

In general, testing is finding out how well something works. In terms of human beings, testing tells what level of knowledge or skill has been acquired. In computer hardware and software development, testing is used at key checkpoints in the overall process to determine whether objectives are being met.

6.2 TYPES OF TESTS CONSIDERED

1. Unit testing
2. Integration testing
3. System testing
4. Sanity testing
5. Smoke testing
6. Interface testing
7. Regression testing
8. Alpha Testing
9. Beta/Acceptance testing
10. Backend Testing
11. Browser Compatibility Testing
12. Example Testing
13. Boundary Value Testing
14. Functional Testing
15. GUI Testing

1. Alpha Testing

Before delivering it to the consumer, this testing is done to identify any problems or issues.

2. Unit Testing

This testing is carried out to ensure that all internal programme designs and code are functioning.

3. Backend testing

This testing is carried out to detect problems such as data loss, deadlock, and data corruption. It is critical that the data entered as input to the system be correctly inserted into the database.

4. Browser compatibility testing

Because the system is a web application, browser compatibility testing is important.

5. Boundary value testing

This testing is carried out to see how the system reacts to upper and lower range boundaries..

6. Example Testing

It's critical to test the real-time situation because this system is tied to health.

7. Functional Testing

This testing is done to verify the output of the system.

8. GUI testing

This testing is done to see if the look and feel is proper and easy to use.

9. Integration Testing

This testing is done to check if everything works fine after integrating all the modules.

6.3 Various test case scenarios considered

1. Check system behavior for the functioning of integrated modules.
2. Check system behavior when correct output is obtained for real time scenarios.
3. Check system behavior when boundary values are inserted.
4. Check system behavior for the output of every internal program design and code

6.4. Inference drawn from the test cases

After completing all of the tests, it may be concluded that the system functions properly in all scenarios. Various algorithms were utilised, with CNN and Darknet19 + Residual Layers+ LSTM providing the best accuracy and performance across the board. The system was discovered to be compatible with a variety of systems. It also displayed the same user interface as expected.

CHAPTER 7

7.1 SCREENSHOTS OF USER INTERFACE (UI) FOR RESPECTIVE MODULE

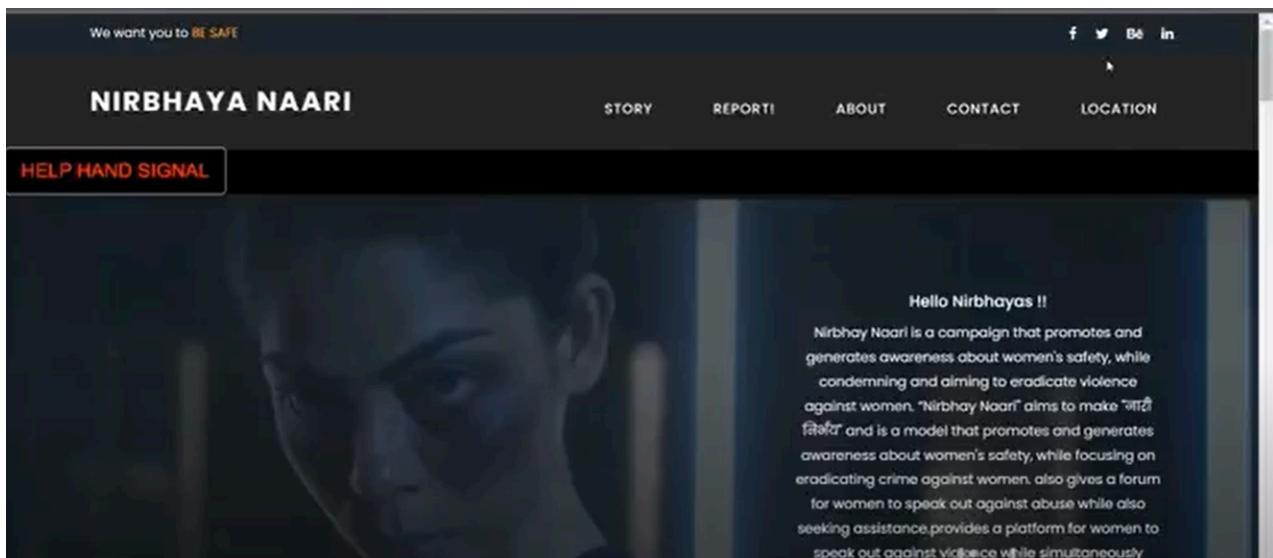


Fig 12. Homepage of portal “Nirbhaya Naari”

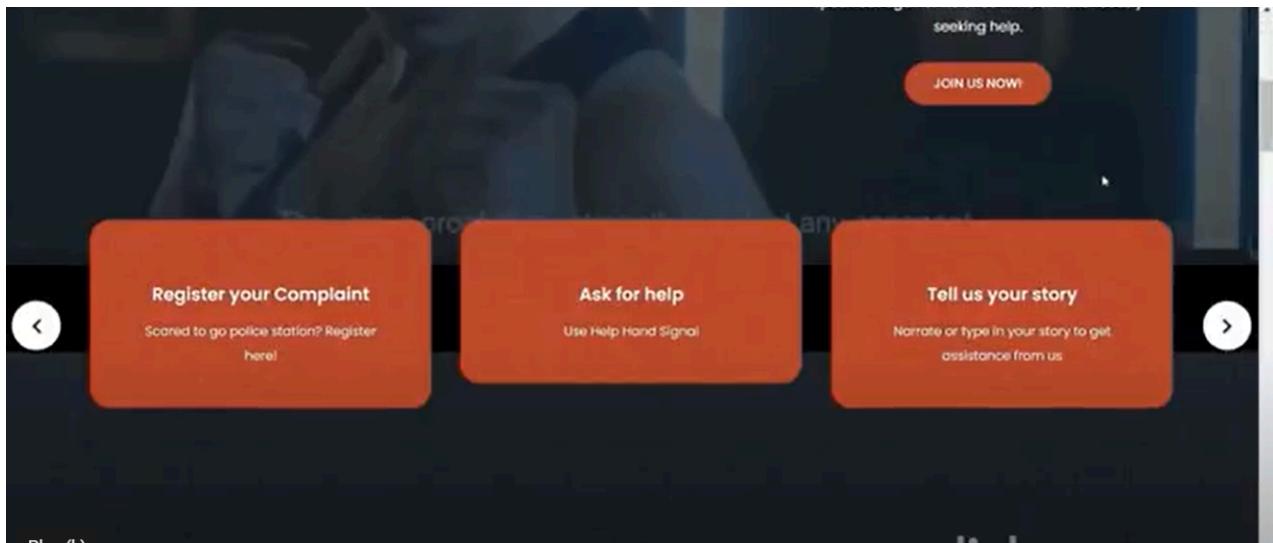


Fig 13. Additional functionalities of our portal

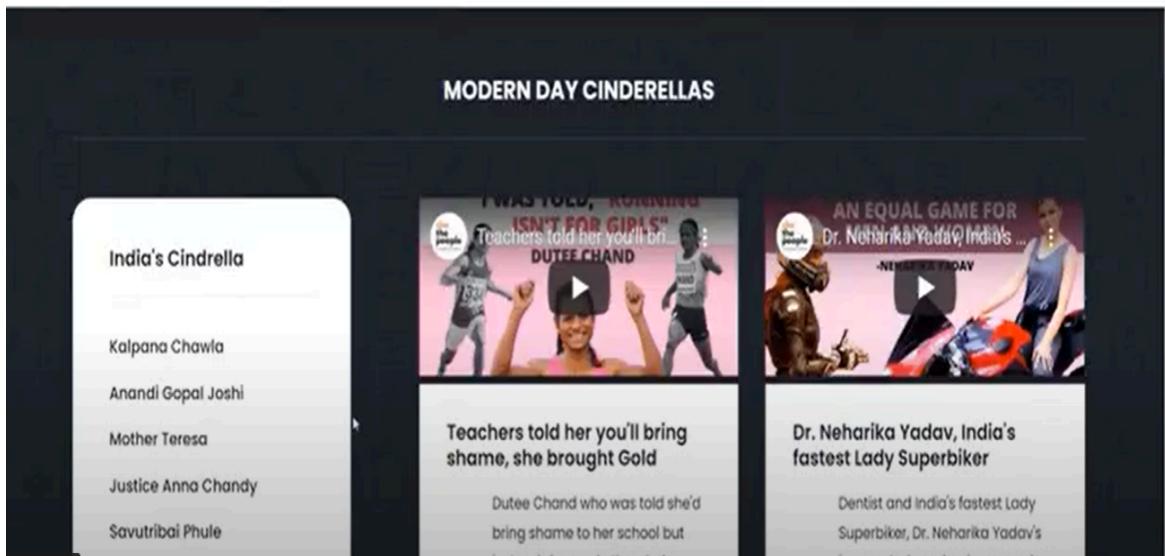


Fig 14. Additional functionalities of our portal

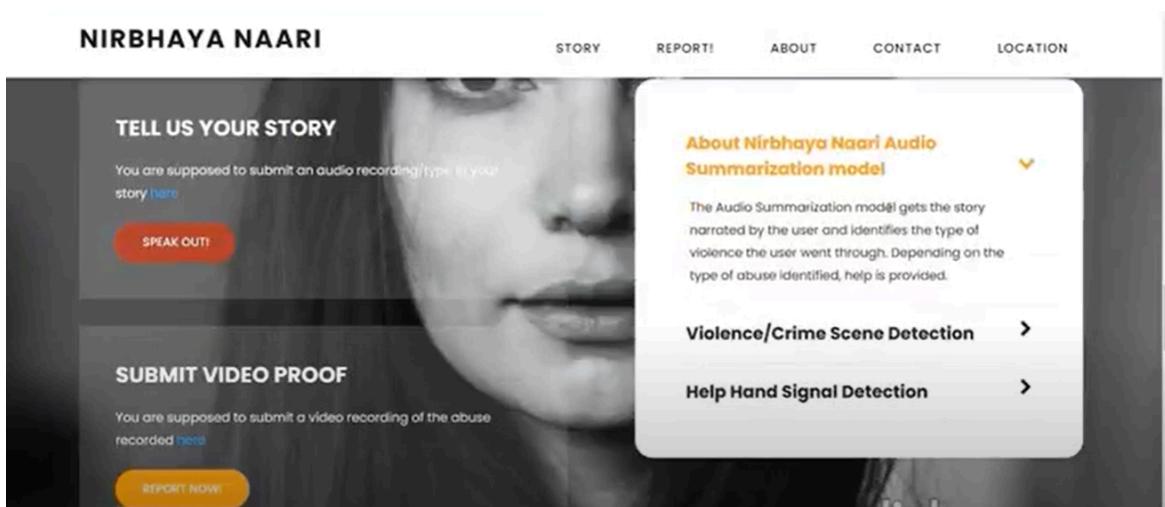


Fig 15. Section for victim to provide audio/video proof of her violence



Fig 16. Section displaying the accuracy of our models

The figure is a screenshot of a web page titled "NIRBHAYA NAARI". At the top, there is a navigation bar with links for "STORY", "REPORT", "ABOUT", "CONTACT", and "LOCATION". Above the navigation bar, the text "We want you to BE SAFE" is displayed, along with social media sharing icons for Facebook, Twitter, Be, and In. The main content area features a large image of a person's face. Overlaid on the image is the text "Tell us your story!". Below this, there is a text input field with the placeholder "Text:" and a note "You may type your story here". There is also a file upload input field with the placeholder "Choose File" and a "Upload" button. The background of the page shows a dark image of a person's face.

Fig 17. Section for victim to write or narrate the story

"You are not alone."
"It is NOT your fault."

DOMESTIC VIOLENCE | HELPLINES

AZAD FOUNDATION +911140601878 Driven by the vision of a world where all women enjoy full citizenship, earn a livelihood with dignity and generate wealth and value for all. VISIT NCW	OPERATION PEACEMAKER 18002129131 Aims to reduce domestic violence in India through thousands of PeaceMakers who are trained in family and marriage counseling and all aspects of the Domestic Violence Act.	AKS FOUNDATION 8793088814 Provides support to victims, from all over the country and abroad, of abuse and violence in order to empower them to become survivors. VISIT AKS FOUNDATION
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Fig 18. Output depicting the type of violence after narration of story

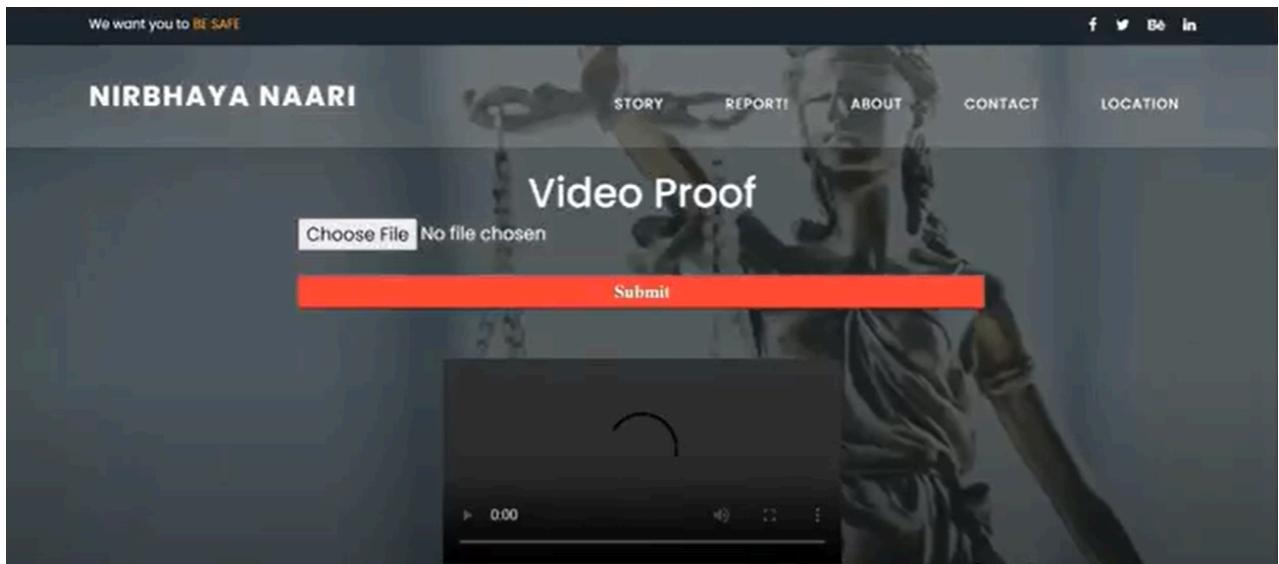


Fig 19. Section for victim to upload a video proof of her abuse

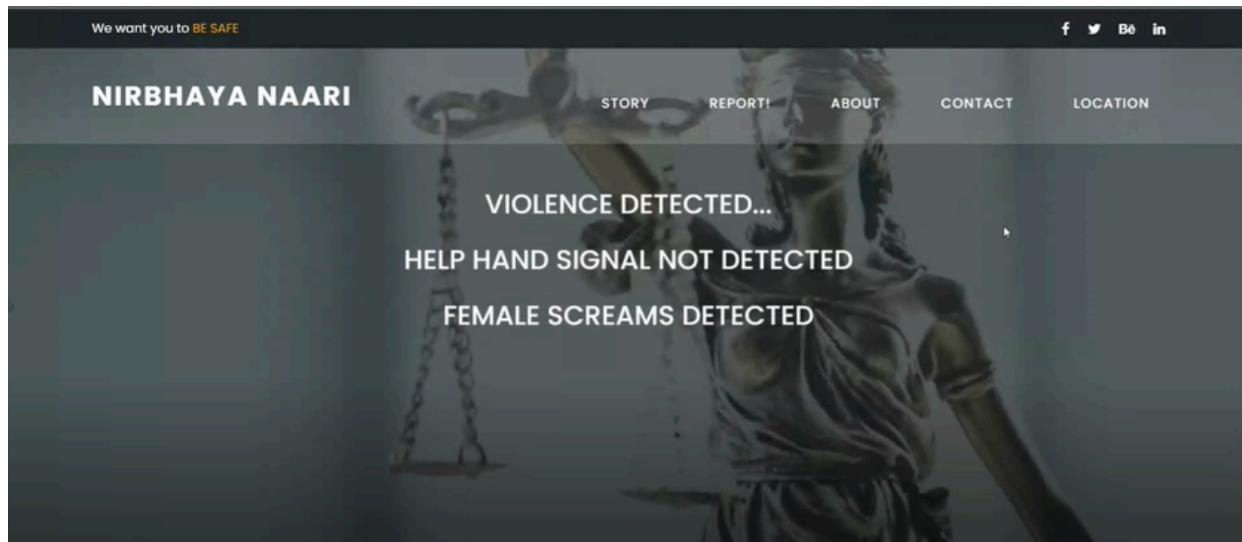


Fig 20. Portal detecting the presence of violence

This screenshot shows the contact form section of the NIRBHAYA NAARI website. On the left, there is a white form with fields for "YOUR NAME...*", "YOUR EMAIL...*", and "SUBJECT...*". Below these is a larger text area for "YOUR MESSAGE...". At the bottom of this section is a red button labeled "SEND MESSAGE NOW". To the right of the form is a vertical orange sidebar containing contact details: "Phone Number" (010-020-0340), "Email Address" (info@meeting.nn), "Street Address" (XYZ), and "Website URL" (www.meeting.nn).

Fig 21. Let's get in touch or Contact us page

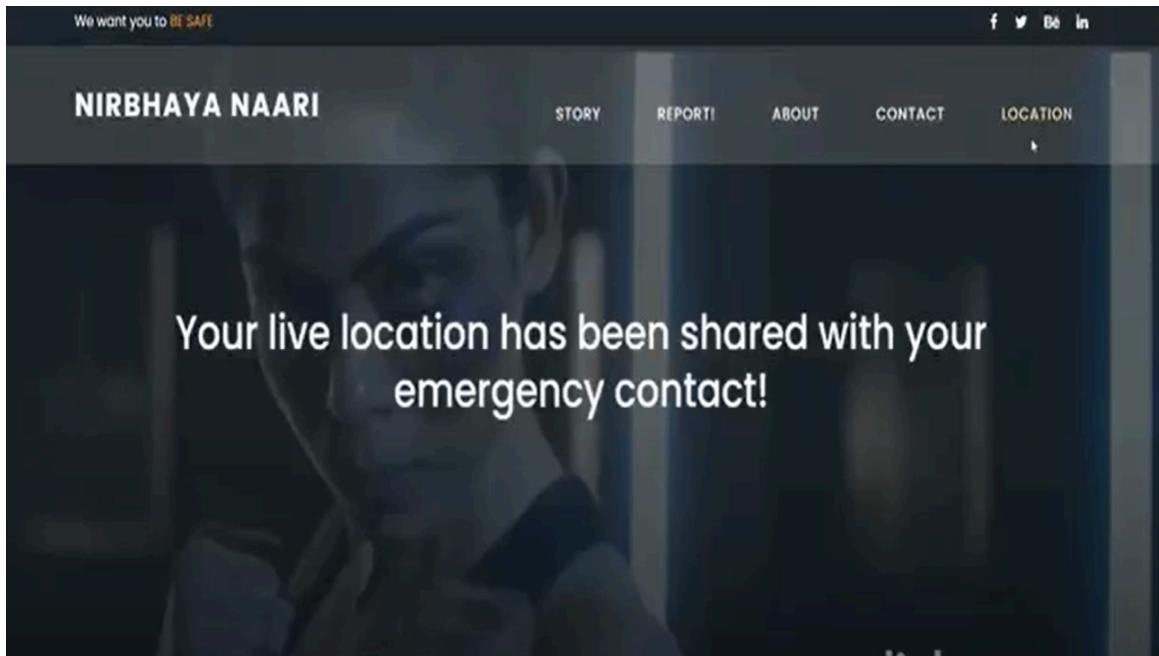


Fig 22. Sharing live coordinates of victim with her emergency contact

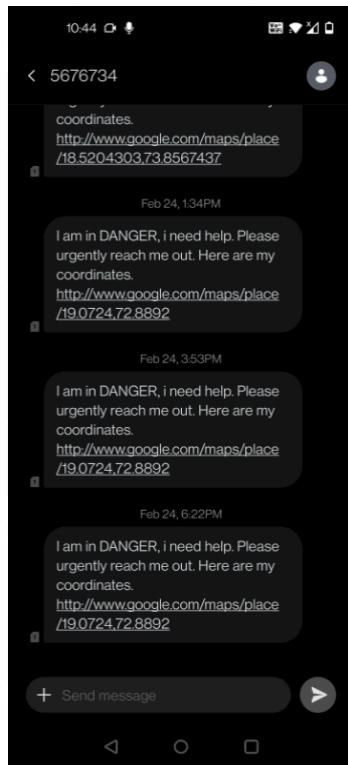


Fig 23. Message shared with the emergency contact of the victim

7.2 PERFORMANCE EVALUATION MEASURES

For help hand signal detection we got the accuracies as follows

Help Hand Signal Detection	
Model	Accuracy
CNN	96.42
Inception V3	90
DNN with SqueezeNet	83.28
ANN	79.89

Table 1. Performance evaluation for help hand signal detection

For multi-label classification we got the accuracies as follows

Multi-label Classification of text and audio					
Model	Accuracy	Recall	Precision	F-measure	mean_pred
NN	0.921	0.861	0.833	0.879	0.385
CNN	0.926	0.865	0.856	0.88	0.397
RNN	0.914	0.829	0.819	0.861	0.393
CNN-Glove	0.912	0.805	0.755	0.847	0.418
RNN-Glove	0.908	0.788	0.797	0.831	0.433
CNN-Word2Vec	0.916	0.804	0.714	0.826	0.452
RNN-Word2Vec	0.912	0.825	0.798	0.825	0.47

Table 2. Performance evaluation for multi-label classification of stories

Audio-Video conversion and detection of Harassment and NLP based Summarization		
Model	Accuracy	Confusion Matrix
XGboost	29 %	[[67804 15825] [18851 62615]]
DecisonTree	49 %	[[69716 13913] [14162 67304]]
RandomForest	66 %	[[73615 10014] [8231 73235]]
Passive aggressive classifier	89.58%	[[210 190] [109 291]]

Table 3. Performance evaluation of proposed work with different classifiers for Audio-Video conversion and detection of Harassment and NLP based Summarization

Violence/Crime Scene Detection Module	
Model	Accuracy
Conv3D	91.00%
Darknet19 + Residual Layers+ LSTM	98.50%

Table 4. Performance evaluation of proposed work with different classifiers for Violence/Crime Scene Detection Module

7.3 GRAPHICAL / STATISTICAL OUTPUT

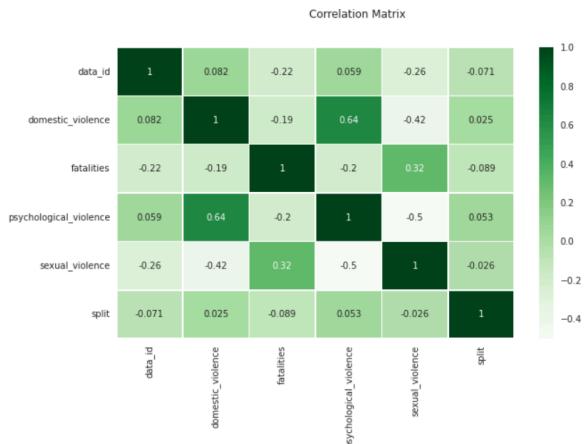


Fig 24. Correlation matrix of the dataset features for multi-label classification

After training the video dataset we achieved an accuracy of 98.50%. The accuracy of the proposed model for each epoch is shown in Fig.15. Also, the loss (Cross Entropy loss) of both train and test sets are illustrated in Fig. 16.

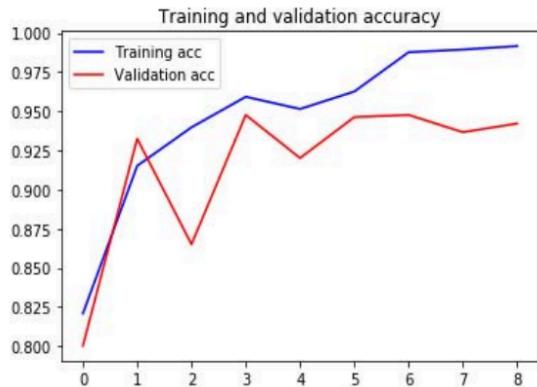


Fig 25. Test Vs. Training Accuracy Graph



Fig 26. Test Vs. Training Loss Graph

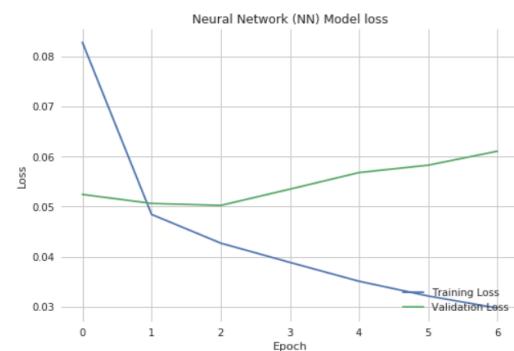
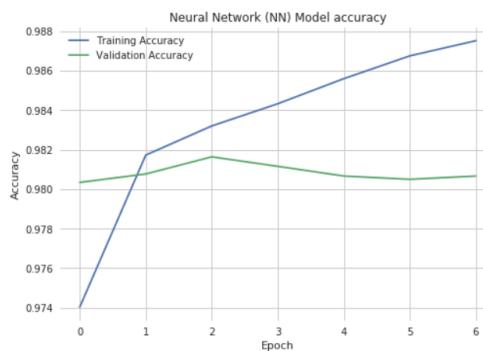


Fig 27. Graph of Training & Validation Accuracy with the Loss values of the NN Model

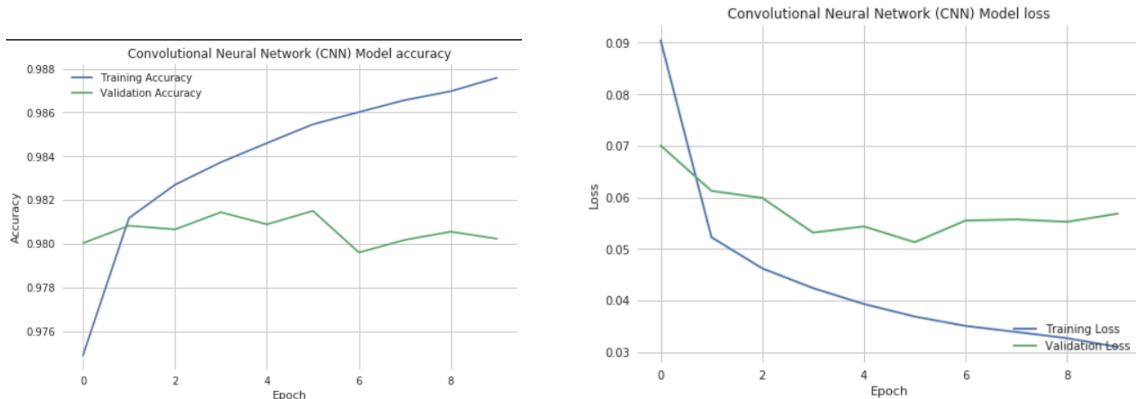


Fig 28. Graph of Training & Validation Accuracy with the Loss values of the CNN Model

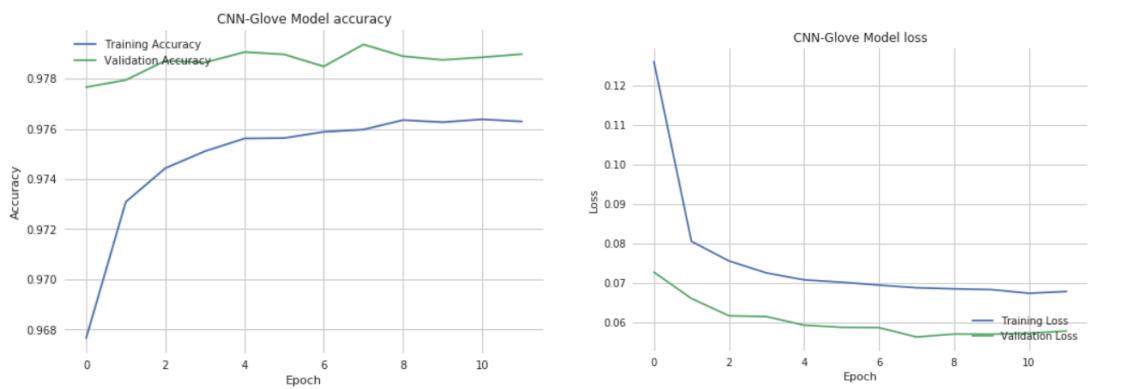


Fig 29. Training & Validation Accuracy with the Loss values of the CNN-Glove Model

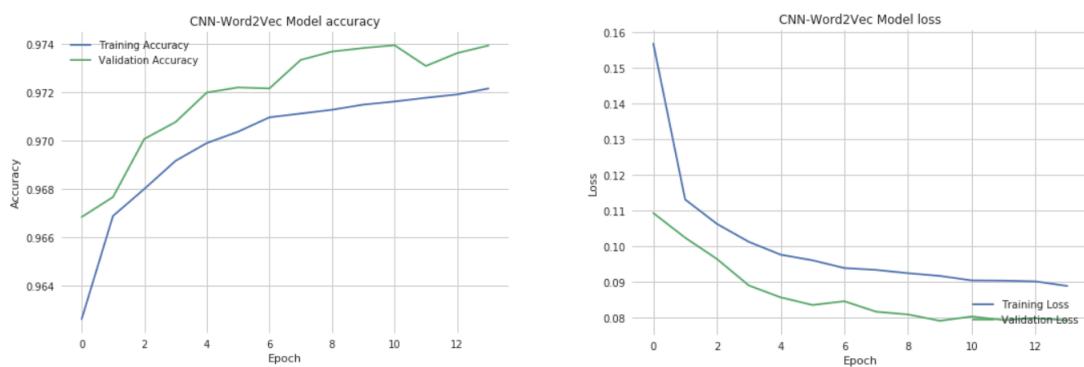


Fig 30. Training & Validation Accuracy with the Loss values of the CNN-Word2Vec Model

7.4 COMPARISON WITH EXISTING SYSTEMS

Comparing it with SHEROES, a women-only community that offers a safe and trusting area. Here, women can talk about many elements of their lives, such as health, careers, and relationships, as well as share their life stories whereas our system detects the violence in real-time and keeps check on the abusers. Although there are existing laws in our country that help women to fight against any kind of violence many times women find these proceedings quite overwhelming and tend to get scared whereas our portal helps women to silently raise their voices against the violence and seek justice. There also exists a chatbot RAINBOW where women can talk about their relationships that don't feel right and it then helps women to navigate through this phase. Our system has a similar portal where a woman can share her audio clips or record audio which can act as proof against violence along with connecting to various helplines near her area.

7.5 INFERENCE DRAWN

From the results above, we concluded that for multi-label classification of text and audio, we used CNN model as it gave us the best accuracy of 92.6% as compared to other models like NN, RNN, CNN- Glove, RNN- Glove etc. For Violence/Crime Scene Detection Module we preferred Darknet19 + Residual Layers+ LSTM.

Hand segmentation, which is a tough operation in photographs with cluttered backgrounds, is not required with the suggested model. Even though there are a variety of segmentation approaches based on skin colour, hand shape, and other factors, they all fail to produce accurate results when applied to photos with other background items. So, for Help hand signal detection, we decided to go with CNN model based on its higher accuracy as compared to other models. This method also eliminates the time-consuming task of identifying prospective feature descriptors capable of distinguishing different gesture types.

CHAPTER 8

8.1 LIMITATIONS

The shortcomings or limitations of our system will be not having

- 1) Multilingual interaction .
- 2) Real time monitoring of places for violence detection.
- 3) Real time tracking of help (police) for help hand signal detection when a victim shares her live coordinates in case of an emergency.

8.2 CONCLUSION

According to the World Health Organization, one in every three women across the globe experience physical and/or sexual violence in their lifetime; and at least 30 percent of all women in relationships have experienced physical and/or sexual violence by their partners. Across the world, countries including China, the United States, the United Kingdom, Brazil, Tunisia, France, Australia, and others have reported cases of increased domestic violence and intimate partner violence. India, infamous for gender-based violence, is showing similar trends.

In this project, we proposed a solution to combat domestic violence and harassment with a real-time violence detector based on NLP and Deep Learning methods. By examining the violence metrics obtained by considering the audio and visuals severity of the solution can be determined.

Depending on the severity of the abuse, necessary actions could be taken. This would not only help in detecting domestic violence but as well help the victim, by giving immediate help in the form of consulting or police assistance.

In a nutshell, our project lays out a platform where women can raise their voices and experience a safer environment. It will also help instill terror in the minds of the abusers before they do any acts of violence. Acts as an aid to ICC thereby helping to reduce the crime rate. It also acts as a women's empowerment tool. It indirectly looks after the mental well being of females which in turn increases their growth in both personal as well as professional life

8.3 FUTURE SCOPE

- 1) Tying-up with the local NGOs to bring awareness about the website.
- 2) Facilitate multilingual interaction to ensure that language does not become a barrier.
- 3) Robust and reliable live CCTV security system for real time violence detection.
- 4) Today Alexa is a humble servant, but tomorrow she could be a rescuer i.e integrating assistants like Alexa with our system

CHAPTER 8

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APPENDIX

REVIEW SHEET

https://drive.google.com/file/d/1ICbu4rP_K5q-OYfS9e2LRTO1w-5KIGEK/view?usp=sharing

PPT

https://docs.google.com/presentation/d/1jCraviLfNwcmoHN4IU4H7Uko077iVOIVI2XO9X9h_X0/edit?usp=sharing

PROJECT VIDEO LINK:

<https://drive.google.com/file/d/1Q2VS3Ipaj-gweDMKGGuTmpBSGL42gIPx3/view?usp=sharing>