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Knowledge, Detection and Reporting of Abuse Using Deep Learning Technologies

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ABSTRACT: One of the major problems that the society is facing right now is physical abuse. The people who are most vulnerable to it are children, women and elder people. There can be various cases where people refuse to report the abuse they experience, either because of they are scared or because they are related to the abuser in some way. Hence, in this paper, we propose a technique that detects cases of abuse and mistreatments by analysing the security camera frames and performing three machine learning models such as YOLO, Deep Sort and Flow Gated network. It shows accuracy of about 90% and precision of about 85%. This shows the effectiveness of the system.

KEYWORDS: Convolution neural network, Deep learning, Human action recognition, Human pose estimation, Physical abuse

I. INTRODUCTION

Nearly 5.3 million incidents of domestic violence occur annually among US women aged 18 years and older, with 3.2 million occurring among men [1]. In 2001, of all nonfatal violence directed against women, 20% was found to be of domestic physical violence, and in men, this number was found to be 3%. A 2002 study reported that almost 1-in-3 women and more than 1-in-5 men report having experienced physical, sexual, or psychological partner violence during their lifetime [2]. Victims of abuse often do not reach out to the police as women report to the police only 25% of all physical assaults and 50% of all stalking perpetrated by partners. This means that doctors at the emergency room, often have the first chance to identify the cycle of physical abuse. And even then, the numbers who go to the emergency room is low with only 14.7% of physical abuse victims saying that would go to the hospital for assistance [3]. It is also a physical abuse statistic that the police spend one-third of their time responding to domestic violence calls. Generally, children are more likely to be the victims of physical abuse caused by caretakers or close ones. Child labour or Child employment can also be forms of mistreatment or abuse. Even older people might be physically abused by younger people. Elder abuse neglect or mistreatment is often done by a caretaker. And those holding higher positions or in power might also physically abuse people working for them. The main form of physical abuse is usually punching, kicking, slapping, beating, caused by fast hand and leg movement. Hence, we can use deep learning technologies to tackle such issues by analysing the live feeds in various places like Child care centres, Elder care centres, Nanny cameras etc. Two methods that can be implemented here are human actions recognition and human pose identification. And to prevent false framing of abuses, it may also identify the chances of it being abuse and chances of it being not abuse.

II. RELATED WORKS

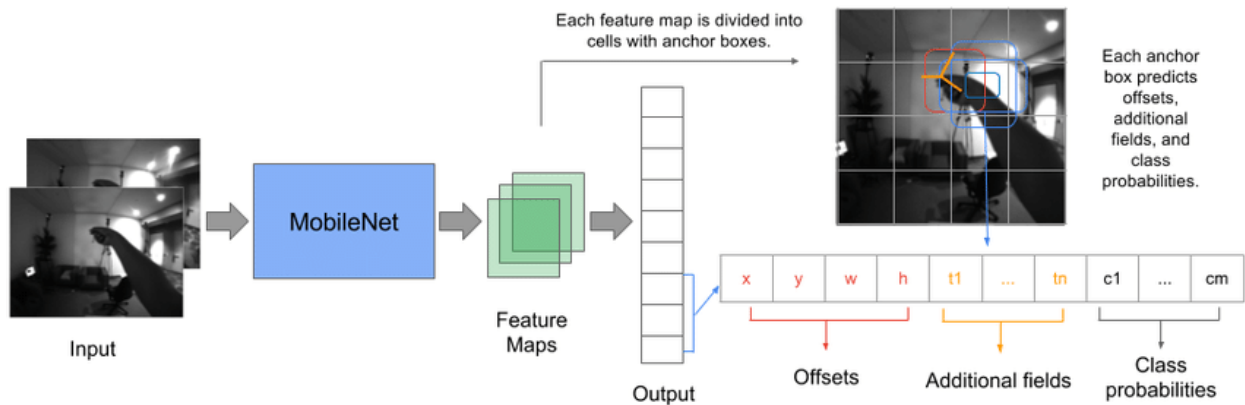
Traditional methods include physical requirements to detect abnormalities such as placing a tracker to child's mobile device or through the hair bands and other physical or location based items to report the incident of abuse. But in recent times, deep learning technologies are being preferred for their ability to detect such cases without the requirements of additional physical or location based device. The accuracy of deep learning technologies to detect and solve real life problems has been pretty high.

One of the previous deep learning approach uses weight sharing, local perception, down- pooling, and a multi-convolution kernel to learn local information from part of an image [4]. The result will be the output from final recognition layer. The final recognition layer will be determined by the result of multiple layers of convolution. And action recognition is considered to be a combination of gestures, for example, "running", can be determined as a combination of arm and leg gestures [5]. Other systems like EADS [6] detects cases of elder abuse by analysing security camera frames and performing real time forecasting using various machine learning models [7]. Fine grained

abuse detection based on four sub-tasks have also been identified- severity, type, target and directness [10]. Tree (GBDT) classifier on averaged word embeddings learnt using a long short-term memory (LSTM) network that they initialized with random embeddings [11].

III.METHODOLOGY

The model architecture of this system is based on the MobileNet SSD deep neural network. Mobilenet SSD is an object detection model that computes the output bounding box and object class from the input image. This Single Shot Detector (SSD) object detection model uses Mobilenet as a backbone and can achieve fast object detection optimized for mobile devices. The working of Mobilenet contains a depth-separable convolution that splits it into two layers, a separate layer for filtering and a separate layer for combining. This factorization drastically reduces the computation and model size. Whereas the SSD technique is based on a forward convolutional network that generates a collection of fixed-size bounding boxes and a score for the presence of object class instances in those boxes, which come behind by a non-maximal suppression step to create the final detections.



Datasets:

The dataset contains video clips of various women, children and elder abuse that were captured by the surveillance cameras in the real-world scene.

The data collection was done by the following method:

1. Collect various videos online by searching them up
2. Cut the videos to 5-second clips and the format is changed to the AVI format
3. Split the data to Train, Validation and Test sets

Model Training:

The models are to be divided into various categories such as normal behaviour, child abuse, child labour, women abuse, elder abuse and adult care. The solution to the lack of quality data was to use 6 data augmentation techniques which change video clips to 90,-90,45,-45 degree, black & white colour and invert colour techniques. The examples of the dataset trainings are as follows:



Steps:

- We take samples from each dataset, 2 frame set each frame set containing 149 frameset, and then save the sampling video in a folder.
- Open the sampling video folder and run YOLO and Deep sort models to predict the tracking bounding boxes in the video.
- Blur each frame set by the bounding boxes and save the videos in a folder.
- If the model identifies each dataset as violence or abuse, then it immediately intimates it to the user email address



IV. EXPERIMENTAL RESULTS

The results and the accuracy of the model can be predicted by comparing it with the previous models.

Metric\Technique	HAR Recognizer
Weighted Accuracy	89.42%
Weighted Recall	85.82%
Weighted Precision	85.82%

The model that is developed is expected to have the following results:

Train Accuracy	Val Accuracy	Test Accuracy	Recall	Precision
<u>0.89</u>	<u>0.829</u>	<u>0.8</u>	<u>0.68</u>	<u>0.89</u>
<u>0.986</u>	<u>0.921</u>	<u>0.84</u>	<u>0.76</u>	<u>0.905</u>

Previous projects have also been concluded with results with accuracies of 99.21%, 84.37%, and 85% for training, validation, and testing, respectively [9]. As we can see, the results show a significant improvement and percentage of accuracy and precision compared to the previous models. A focal-loss function can be used to adapt to the data imbalance and a relative probability score to measure the model's performance [8]. Hence, the model is expected to yield significant results

V. CONCLUSION

The results clearly indicate that an estimation based approach gives good results when it comes to developing a system that is expected to prevent false positives and false negatives. It also shows that the model will perform very well in real time environments especially when the movement of humans can be uncertain and unpredictable and in an environment where giving false positives as predictions can be seen as a harmful and deteriorating result to the people present in the scene. The accuracy of about 92.1% with precision of about 90.5% shows the effectiveness of the system

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