ISSN No:-2456-2165

Fire & Gun Detection using Machine Learning

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Abstract:- Accidental fire is a natural disaster which threatens the public safety in a huge manner. In the past few years, accidental fire has occurred very frequently in many places, including forests, shopping malls and industries, which in turn yields to the huge loss of human lives and capital. By paying attention to simple steps and being familiar with obvious dangers, one can help to lower the likelihood of accidental fires and hinder damage caused to the property or even worse, loss of property. It mainly reduces the risk of potential loss of lives. Possession of fire arms without a license is an offence and even if someone does have a license for it, bringing it to certain places is restricted. Though there is rigorous checking in the entrance of every place, there are possibilities of a mishap. Instead of looking at the whole network, the YOLO algorithm looks into the parts of the image which has high possibilities of containing the object. You Only Look Once (YOLO) is an object detection algorithm, and it is faster than other object detection algorithms.

Keywords:- *Fire detection, Gun detection, YOLO algorithm*

I. INTRODUCTION

Accidental fire threatens public safety and as it is a natural disaster, controlling that is a very difficult task. Over the last few years, accidental fire has frequently occurred in many places, including forests, shopping malls and industries, which has resulted in great losses to human life and finances. In the wake of years of development, Virtual Reality (VR) has evolved rapidly and has converted people's lives by making it easier and simpler than before. Due to the continuous evolvement, virtual reality has become an integral part of the future of the fire detection technology. Currently, we have traditional fire detectors, which include smog detectors, optical detectors, and temperature detectors, which usually have certain defects or restrictions. Smog and flames have specific shapes, textures, colors and other similar features. Hence, people have started to consider the use of computer-based image processing for fire detection.[1]

II. DEFINITIONS

A. Fire and gun detection

Fire and gun detection basically means detecting dangers before they occur. Tools are a great necessity to predict danger before it occurs. Currently, tools like fire alarms and smoke detectors are used by people to detect fire.

B. YOLO Algorithm

You Only Look Once (YOLO) is an object detection algorithm, and it is faster than other object detection algorithms. In the initial detection systems, localizers or classifiers were used to perform detection. The algorithm applies a single neural network to the complete image. The algorithm looks into particular parts of the image and not the complete image. Hence, this algorithm is fast and more effective.

C. Prediction and forecasting

Predicting the cause of fire and possession of guns help in decreasing the loss of life and property. Prediction is based on the previous data and the features extracted from them. The new data captured from the video is compared to the pre-existing data. Later, the danger is predicted based on that.

III. MOTIVATION

Thousands of trees are lost during forest fires and hundreds of people die every year due to fire accidents at home, work place and community areas. A considerable amount of people lose their lives through gunshots. These situations can be avoided by predicting the disasters early.

IV. EXISTING SYSTEM

The current system includes using fire alarms as the main method to detect fire and alert the supervisor. Fire alarms use smoke as its main input, and sometimes it can be deceiving. For example, smoke from incense sticks or camphor. As of now, guns are detected by using metal detectors or by manually checking for guns and the results are not always accurate.

V. PROPOSED SYSTEM

Fire detection by using live camera feed, plays an important role in reducing losses caused by fire, as it alarms the user before in hand, and in turn reduces the risks caused by fire. Image based fire detection is established by analysis of the images algorithmically. The live video is passed through the algorithm and then the YOLO algorithm processes the input data. The system searches for the presence of gun or fire and then detects the same.

If fire or gun is present in the particular video, it will alert the supervisor through SMS. You Only Look Once (YOLO) algorithm is an object detection algorithm which helps to detect fire and gun more efficiently and also in a faster way.

ISSN No:-2456-2165

VI. OBJECTIVE OF THE PROJECT

The video captured by the live camera is traversed through the YOLO algorithm and the algorithm examines the video thoroughly for traces of fire or gun. The extracted features of the video are compared to the pre-existing dataset and the similarities between them is established. If there are any similarities, an alert message about the fire or gun is displayed on the screen.

VII. LITERATURE SURVEY

- *Image fire detection algorithms based on convolutional neural networks*
  Authors: Author: Pu Li, Wangda Zhao

Abstract: Fire hazards are becoming more frequent in recent years. Hence, reducing losses caused by fire is a dire necessity. Alarming users before in hand is one of the main things to do, to reduce risks. By spontaneously extracting image features, the comparison becomes easy. CNN algorithm-based fire detection reports that the accuracy of it is higher than all other algorithms. YOLO v3 gives 83.7% precision which is higher than all proposed algorithms. It also has a great detection performance and the detection speed is around 28 FPS. This enables real-time detection in an easier way.[2]

- *An Early Flame Detection Based on Image Block Threshold Selection Using Knowledge of Local and Global feature Analysis*
  Authors: Ting Hsu, Shreya Pare, Dong Lin Li.

Abstract: Fire is one among the uncontainable events that occur in our day-to-day life. Every year, it is responsible for innumerable human life, flora and fauna. Hence, many researchers have associated themselves with early warning systems to minimize the fire damage and the resulting consequences. In this paper, the occurrence of fire is classified into four periods, namely, inception, fire growth period, fully developed period and decay period. The flame detection is done by considering four categories, namely, shape, color, motion and texture. The system has 97% detection rate and about 3.5% false alarm rate. The processing time is 5 ms per frame. [3]

- *Batik Image Classification Using SIFT Feature Extraction, Bag of Features and Support Vector Machine*
  Authors: Ryfial Azhar, Desmin T uwohingide, Dasrit Kamudi

Abstract: Batik is an Indonesian traditional fabric which is also its cultural heritage since 2009 [4]. Batik image sorting and grouping is required to protect the resources of traditional art of Indonesia. Hence, a feasible technique is important to extract the distinctive characteristics of batik image. Bag of Features (BOF) is used in the image classification along with Scale-Invariant Feature Transform (SIFT) and Support Vector Machine (SVM) classifier [5][6]. The observation results show that the mean accuracy of this reaches 97.67% for normal image, 95.47% for rotated image and 79% in scaled image. [7]

VIII. OBJECTIVES OF LITERATURE SURVEY

- Accidental fire is one among the main causes for the loss of human and animal life globally
- By alarming users before in hand, we can minimize the consequences of fire hazards
- If fire can be contained in the early stages, loss of lives and property can be avoided
- Early warning systems are the future and they need to be researched well to provide a fool proof security

IX. SCOPE OF THE PROJECT

The video captured from the camera is passed through the YOLO algorithm and the algorithm looks through the video for traces of fire or gun. The extracted features from the video are compared to the pre-existing dataset and the similarities between them is established. If there are any similarities, an alert message about the fire or the gun is displayed on the screen.

X. SYSTEM ARCHITECTURE

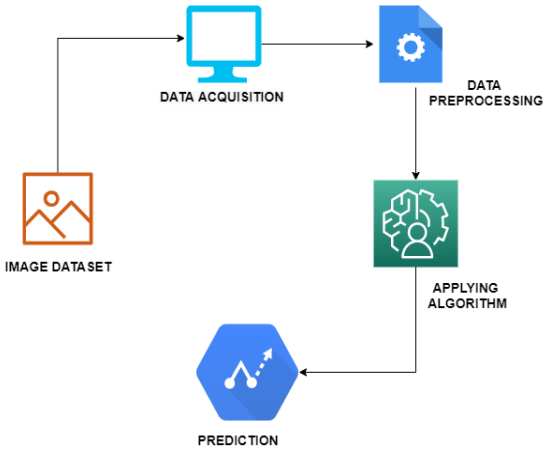

Fig 1: System Architecture

The fire and gun detection system considers the live video as input data, then it preprocesses the data and extract the features. Later, YOLO algorithm is applied to compare between the new data and the pre-existing data and then, the system predicts the presence of fire or gun in the live video.

XI. DATAFLOW DIAGRAMS

A dataflow diagram or DFD gives a detail approach of the inputs and the outputs of each process. It specifies the flow of data without any particular kind of loops or rules. DFD mainly focuses on expressing data by the flowchart. It consists of different steps of a process in systematic order.

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DATA FLOW DIAGRAM - LEVEL 0

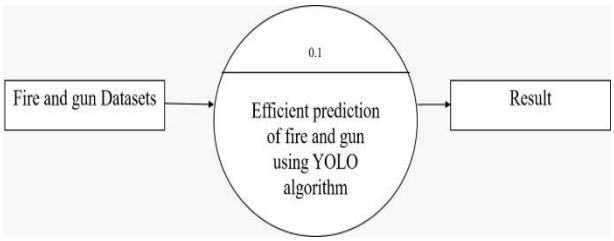

Fig 2: Data Flow Diagram – level 0

LEVEL 0 Data flow diagram is an aerial view of the entire system in a single process along with its external entities and the relationship between them. It is also known as Context Schema. It describes the overall process of a project. The live camera feed is passed as input to the system and the system uses YOLO algorithm to detect the presence of fire and gun. It displays the result at the end.

DATA FLOW DIAGRAM – LEVEL 1

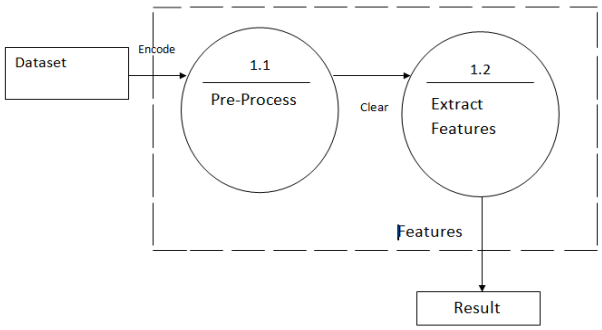

Fig 3: Data Flow Diagram – level 1

LEVEL 1 DFD is a LEVEL 0 diagram split into different processes. It highlights the main function of the system. In this level, the high-level process of 0-level DFD is divided into sub processes by identifying the important features of the system. We pass live video as input to the system. It preprocesses the input data and extracts all the important features in them. Later, the result is displayed.

DATA FLOW DIAGRAM – LEVEL 2

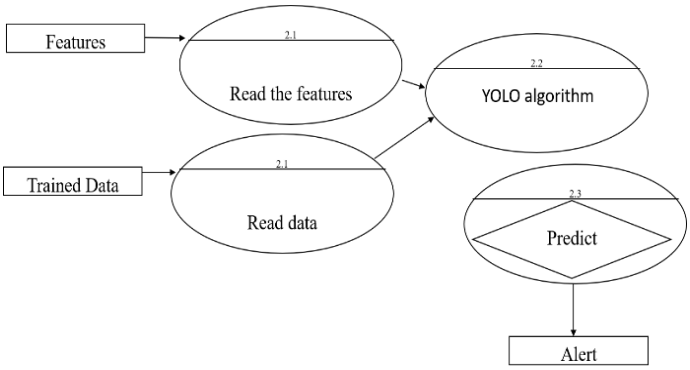

Fig 4: Data Flow Diagram – level 2

Level 2 DFD goes one step deeper into parts of level-1 DFD. It can be used to plan or record the necessary details of the system's functioning**.** It describes the final stage of the project. In Fig 4, we are passing extracted features from level 1 and the trained data as input, the system compares both of them using YOLO algorithm and predicts the existence of fire or gun in the live video.

XII. USE CASE DIAGRAM

Use case diagram is an illustrative representation of all the possible interactions with the system. It is basically the communication between the user and the system. The use case diagram is drawn for revealing the functionality of the system. The actors are displayed using stick figures and the rest of it by using either ellipses or circles. It includes everything from loading the dataset to alerting the supervisor.

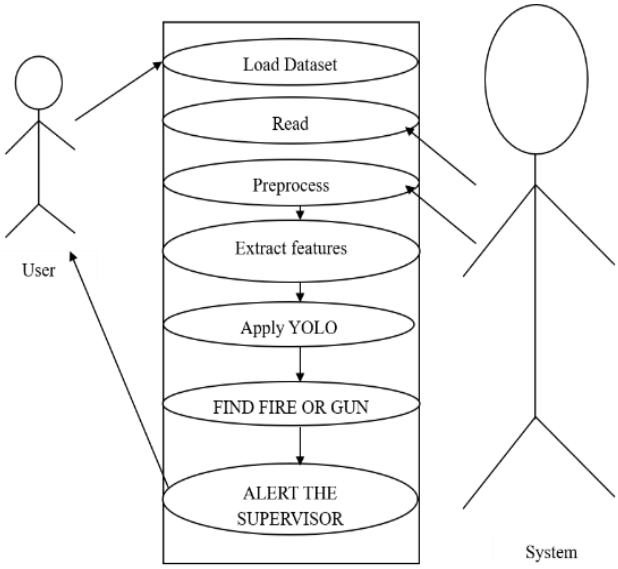

Fig 5: Use Case Diagram

XIII. CLASS DIAGRAM

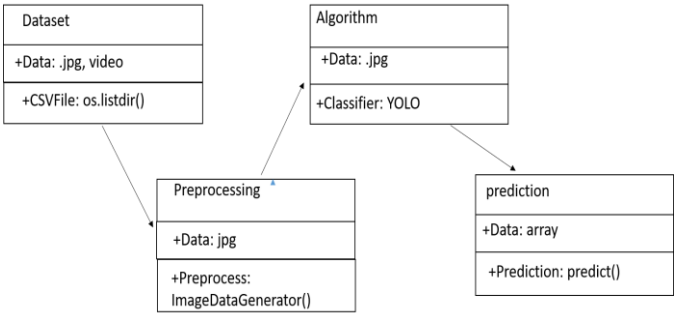

Fig 6: Class Diagram

This schema represents the class diagram of the project. It is constituted by the type of objects present in the system and the relationship between them. The four classes we see here are, dataset, algorithm, preprocessing and prediction. There is a relationship between the classes and the classifiers. The arrow mark shows the dependency of classes on one another.

ISSN No:-2456-2165

XIV. SEQUENCE DIAGRAM

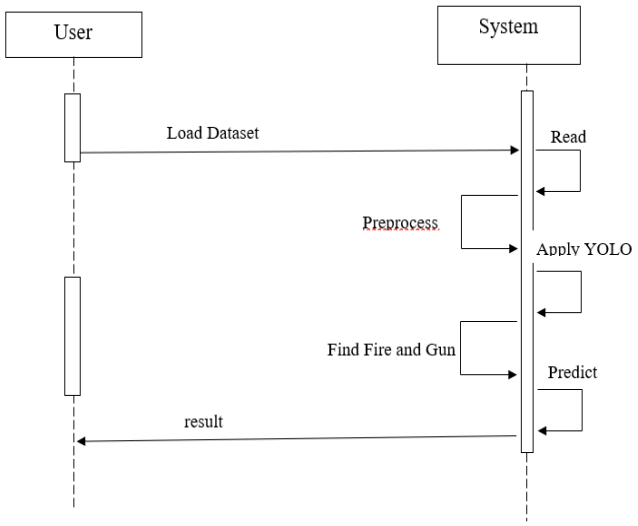

Fig 7: Sequence Diagram

This model represents the sequence diagram of the project. A sequence diagram is a kind of interaction schema because it represents how and what type of objects work together. Sequence diagrams are sometimes called as even diagrams or even scenarios. It represents the data exchange between the user and the system.

XV. ACTIVITY DIAGRAM

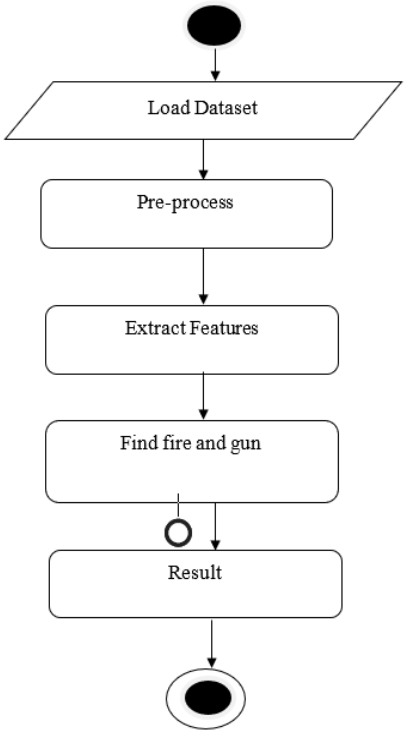

Fig 8: Activity Diagram

The activity diagram is an illustration of stage-by-stage activities of the project. It shows the workflow from one activity to another. It loads the data from the camera, pre-processes it and extract the necessary features. After the comparison is done, the presence or absence of fire and gun is established. The result is displayed on the screen. If there is any danger, a SMS will be sent to the supervisor.

XVI. CONCLUSION

Fire hazards are very common in our day-to-day life and the losses caused by them are quite high. Smoke detectors and fire alarms are some of the methods used to notify people of the disasters that are yet to occur. But, one drawback of these things is, they sense danger only after it has spread to some extent.

By paying attention to simple steps and being familiar with obvious dangers, one can help to lower the likelihood of accidental fires and hinder damage caused to the property or even worse, loss of property. It mainly reduces the risk of potential loss of life. Possession of fire arms is an offence and this method helps us to detect it by minimizing the consequences.

Using this system will help us detect danger in the early stages, which in turn reduces the loss of lives and property.

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