International Journal for Research in Engineering Application & Management (IJREAM)
ISSN : 2454-9150 Vol-05, Issue-08, Nov 2019

Smart Surveillance and Retaliation Using UAV

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Abstract: Nowadays, considering the increasing terrorism and violence, there is a necessity of strong surveillance for maintaining the security and safety of people. Taking into account the present surveillance system, it provides CCTVs which are immobile, providing footage for limited area or humans, but they can't enter restricted areas or unexplored places which might have unknown dangers.Our project aims on developing an aerial surveillance and retaliation system using an UAV or a drone. This system will be a suitable and cost effective option to the present surveillance systems. It can be used in endearing activities to control the violence and destruction that takes place during riots. It will also provide real time monitoring of a region at any time of the day. It will be providing a constant real time video surveillance through wireless communication along with its location details. It intends to provide more options for Indian defence with the help of UAV. By using the UAV military personnel can assess the border situation without putting themselves in danger.The UAV is equipped with powerful face and object detection and recognition tools which will help find any questionable behaviour of a person and contraband objects. After said person is identified system will alert the authorities regarding the level of threat. The authorities will decide whether or not to take actions on said threat commanding the UAV to either stand down or retaliate.It will be also armed with a weapon to control or destroy the threat. The weapon attack will be implemented using a robotic arm. Aiming at giving mobility to a robotic arm mounted to the drone, so that it can perform tasks like detonating or bombing out or attacking with tear gas. The robotic arm will consist of a transmitter and a receiver to send and receive signals to and from the controller. Such a system would lead to timely action in a crime or terror attack prevention. And also control any situation without harming anyone.

Keywords **- Flying Robot, Convolution Neural Network, Speeded-Up Robust Features, UAV, Video Stabilization, Surveillance, Image capture.**

I. INTRODUCTION

Unmanned aerial vehicles are commonly known as Drone. It is nothing but a flying robot. It works with GPS along with the flying machine may be controlled remotely. UAV are more commonly used in military applications but they can also be used to do search and rescue, firefighting and traffic monitoring. Military drone manufacturers are also looking for an upgrade civilian uses for remote sensing drones to spread their markets and this includes the use of drones for surveillance where it's needed. Drones will no doubt make possible the dramatic change in the surveillance state. With the convergence of other technologies it may even make possible machine recognition of faces, behaviors, and the monitoring of individual conversations We are developing a small sized UAV which will be able to recognize faces and objects using CNN and will be fitted with robotic arm which will be used to retaliate if threat level is high and the authorities have authorized said retaliation.

The UAV developed must be stable to produce legible images for processing so for image stabilization we are using SURF algorithm. SURF algorithm is based on SIFT algorithm but has better computation speed hence it is more suitable to use with an UAV.

Google TensorFlow [7] is a platform for building models in machine learning. It's mostly used for developing neural lnetworks. The basic unit in TensorFlow is a computational graph ,which consists of nodes, which are operations, and edges which represent tensors. We are using TensorFlow to develop a convolutional neural network to identify and recognize faces and objects which might have intentions to cause harm to society.

A Convolution Neural Network is deep learning algorithm which can take in an input image, assign importance weights and biases to different objects in the image and be able to distinguish one from the other. The

 DOI : 10.35291/2454-9150.2019.0512

difference between a neural network and CNN is that the input to a neural network is a vector, and the input for a CNN is a multi-channeled image. We are using CNN to distinguish between normal and harmful objects as well as suspicious people according to the database.

II. Related Work

In recent times we have observed the large-scale adoption of UAV for use in educational, law enforcement, and national security applications just to name a few. Today the drone technology is not just limited to military but can be used by everyone by purchasing a UAV to capture images from a store. An UAV is a remotely operated aircraft that is able capture images of a targeted region and transfer them to a server for storage and processing. A drone is usually controlled by a device such as a radio controller, a mobile phone or a tablet or it can be automated to go around a designated path. However, UAV can be misused to do illegal activities like invasion of privacy, smuggling of unlicensed items, spying on suspicious individuals or nations just to name a few. The potential misuse of drones has led to development of new branches in cyber-crime divisions [1].

Currently, there are no small UAV based surveillance and retaliation system to guard and protect India's border. India is a country which has borders in some of the harshest conditions existing in the world. Due to these border conditions a UAV based surveillance system is necessary to avoid large loss of life. The Defense Research and Development Organization (DRDO) program of Indian Defense operate UAV's at altitudes over 12,000m, above the air traffic to conduct surveillance [2]. Our Operational scenario is different: Our UAV will approach a target at medium/low altitude (often less than 100m above the ground) to inspect a target at close range.

Videos of a specified area can be acquired using an UAV but as we are developing a small sized UAV there is a chance that it will jitter easily because of wind and mechanical components fitted to it resulting in unstable video footage captured using UAV camera. To reduce this, image stabilization needs to be done. Compared to mechanical and optical image stabilization, electronic image stabilization is more feasible because of its high accuracy and low-cost [3].

Our system uses Convolutional Neural Network (i.e. CNN) for detection and recognition of human and object. The detecting neural network has 3 layers with no linear activation function. The primary size of pattern used for learning is not so big. The next learning patterns are added at a fixed intervals. CNN accelerates a single iteration of learning algorithm, because it removes patterns which do not bestow to learning process[4].

At present, the recognition system uses computer vision, image processing to extract human characteristics. Face recognition has some drawbacks. At a primary stage, the face will have different expressions and it also changes with time, and some insignificant changes like glasses and makeup can also cause recognition errors [5].

In face detection technology, there are mainly two methods used, namely; feature-based detection and statistical-based detection method. Feature-based detection is more reliable but it depends on light, pose and other conditions. On the other hand, Statistical-based algorithm cannot do real-time detection as per people's requirement. Statistical process can be more reliable if a greater number of training samples are used. Among them, the fastest method is adaboost algorithm[6]. In our work, we use Adaboost algorithm for real time face detection by training the cascade classifier.

III. Problem Statement

Nowadays, both international and domestic threat has evolved significantly. Preventing the terror attacks always remains the first priority of any nation. Multiple influences can lead to the terror attacks like disputes between countries or attacks carried out in the name of religion. Rather than looking for the causes of terrorism itself, a better approach is to determine the conditions that makes the terror possible.

One of the major factors could be inefficient surveillance system. Our project aims at utilizing an UAV a surveillance tool for monitoring a remote location. It will be capable of detecting and recognizing suspicious objects based on the database provided. Also it will alert the authority about the threat and respond back.

IV. System Architecture

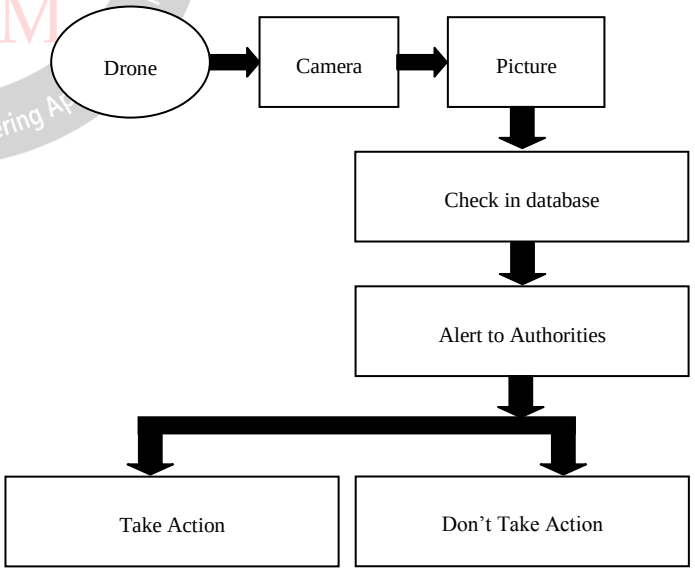

Fig. 1 System Architecture

The UAV will capture the images of the required area using the camera located on it. The image will be checked with the database in real time and an alert will be generated. The Alerts will be classified based on the threat level.

Level 1: Low level Threat (Suspicious movements

 DOI : 10.35291/2454-9150.2019.0512

detected)

Level 2: Medium level Threat (Suspicious objects detected (Small Guns, Knives, Metal objects)

Level 3: High level Threat (Suspicious person and object (Bombs, Automatic weapons) detected)

These Alerts will be sent to the person of authority and he/she will decide whether an action needs to be taken as well as deciding what action needs to be taken.

Actions:

The UAV will be attached with a metallic arm this arm will be able to handle weapons/objects which can be used to retaliate against the person.

Weapons/objects include,

1. Grenades (For Border Security)
2. Smoke/tear gas grenade (For Riot/Crowd control)
3. Packets (For natural calamities help)
4. Guns

V. Design Goals

The UAV must be able to capture clear and precise images for face and object recognition. The real-time images gathered from the UAV will be filtered using CNN by the system to recognize the faces and objects against the given database. The system must also assess the situation and generate a threat level which will be informed to the authorities. The UAV must be able to either stand down or retaliate based on the orders from the authorities.

VI. Algorithm Used

A. *Convolutional Neural Networks (CNN)*

I. Provide input image into convolution layer

II. Choose parameters, apply filters with strides, padding if requires. Perform convolution on the image and apply ReLU activation to the matrix.

III. Perform pooling to reduce dimensionality size

IV. Add as many convolutional layers until satisfied

V. Flatten the output and feed into a fully connected layer (FC Layer)

VI. Output the class using an activation function (Logistic Regression with cost functions) and classifies images.

B. *SURF (Speeded-Up Robust Features)*

1. *Video Stabilization*

Video is a visual interactive media source formed by combining the sequence of images and the combination of frames captured in air rather than on ground are called aerial videos. Aerial video surveillance means capturing data from air so as to monitor the change in information usually of people to influence, manage, direct, or protect them. The main task of video surveillance is to track the moving object in moving platform because aerial video surveillance suffers from undesired motion of cameras due to which there is shakiness in the video. Therefore, there is need for video stabilization algorithm to remove the shakiness.

2. *Aerial video stabilization using SURF and Extended Kalman filters:*

Aerial video stabilization using SURF and Extended Kalman filters approach uses SURF feature detector to detect the features for estimating the global motion followed by outlier removal using RANdomSAmple Consensus (RANSAC) and then extended Kalman filters are applied to filter the noise. After estimating the global motion, affine transformation is used for motion compensation thus stabilizing the video.

VII. Expected Results

The UAV will be able to capture clear and precise images for face and object recognition. The real-time images gathered from the UAV will be filtered using CNN by the system to recognize the faces and objects against the given database. The system should also assess the situation and generate a threat level which will be informed to the authorities. The UAV will be able to either stand down or retaliate based on the orders from the authorities.

VIII. Conclusion

Please include a brief summary of the possible clinical implications of your work in the conclusion section. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. Consider elaborating on the translational importance of the work or suggest applications and extensions.

Acknowledgment

THE AUTHORS WISH TO THANK PROF.A.S.CHADCHANKAR.

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