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IDENTIFICATION AND CLASSIFICATION OF DRONES USING KNN

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Abstract: Flying drones in safety zones is strictly prohibited. However anti-social elements are likely to hit important targets in such zones, by using drones. The aim of this project is to continuously monitor safety zones using SAR images and raise an alarm as soon as a Drone is detected. This project contains three modules: DII (Drone Image Input) module is used to provide different drone images as input for the system. The DI (Drone Identification) module is used to monitor the images of the safety zone and to identify drones when they enter the safety zone. The 'alarm' module is used to send the message to the safety officers as soon a Drone is detected in the safety zone. This project uses the OpenCV algorithm to identify different types of drones and distance calculation algorithm to measure the distance of the Drone from the safety zone. The images of various types of drones are stored in an image file system. The file system will be stored at a specific location in directory structure. The location will be fed as input to the system. KNN classification is used to classify the drone as one of the drones types. The k-nearest neighbors algorithm (k-NN) is a non-parametric method used for classification. The input consists of the k closest training examples in the feature space. The output is a class membership. An object is classified by the class that is most common among its k nearest neighbors. The classification is based on the length, width, height and curvature of the drones.

Index Terms **- OpenCV, SAR images, distance calculation algorithm, KNN, classification**

I. INTRODUCTION

The Unmanned Aerial Vehicle (UAV) (or uncrewed aerial vehicle, commonly known as a drone) is an aircraft without a human pilot on board and a type of unmanned vehicle. UAVs are a component of an unmanned aircraft system (UAS); which include a UAV, a ground-based controller, and a system of communications between the two. The flight of UAVs may operate with various degrees of autonomy: either under remote control by a human operator or autonomously by on board computers.

Compared to crewed aircraft, UAVs were originally used for missions too "dull, dirty or dangerous" for humans. While they originated mostly in military applications, their use is rapidly expanding to commercial, scientific, recreational, agricultural, and other applications, such as policing and surveillance, product deliveries, aerial photography, infrastructure inspections, smuggling and drone racing. Civilian UAVs now vastly outnumber military UAVs, with estimates of over a million sold by 2015. This is why because Drones are cheap, easy to fly, and widely available to consumers nowadays.

To overcome the problem of drone attack this project entitled “Identification and classification of drones using KNN” useful. There are many way to identify the drones, but they require costly hardware and software. But this project is cost effective high accuracy and easy to use. There are three aims of this project, they are, first one is to identify the drone around the safety zone places, second one is classify the type of the drone and third one to calculate the distance between the drone and the safety zone.

The Templet Matching is used to detect the drone. Template Matching is a method for searching and finding the location of a template image in a larger image. OpenCV comes with a function cv.matchTemplate() for this purpose. It simply slides the template image over the input image (as in 2D convolution) and compares the template and patch of input image under the template image. Several comparison methods are implemented in OpenCV. It returns a grayscale image, where each pixel denotes how much does the neighbourhood of that pixel match with template. KNN algorithm is used to classify the type of drone. The k-nearest neighbors algorithm is a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. The distance calculation algorithm is used to find distance between drone and safety zone, and detects the direction of drone moving. The is calculation is based on the time taken by ultrasonic sensor.

This project is implemented in python which is robust, easy to understand. We can minimize the code through various predefined functions in Python. To develop this project, we have used different tools like PYQT Designer, PYUIC and python. Each and every tool plays a major role. PYQT Designer tool is used to design needed Graphical User Interfaces, PyUic tool is used automatically generate the code for the Front end user interfaces created by PyQt. All the front end python code is automatically generated by this tool, by converting the user interface (.ui) files into .py files.This Project uses PyQt tool to create the needed Graphical User Interfaces, PyUIC module to automatically generate the code. PyUic tool is used automatically generate the code for the Front end user interfaces created by PyQt. All the front end python code is automatically generated by this tool, by converting the user interface (.ui) files into python (.py) files.

II. LITERATURE SURVEY

The earliest recorded use of an unmanned aerial vehicle for warfighting occurred on July 1849, serving as a balloon carrier (the precursor to the aircraft carrier) in the first offensive use of air power in naval aviation. UAV innovations started in the early 1900s and originally focused on providing practice targets for training military personnel. UAV development continued during World War I, when the Dayton-Wright Airplane Company invented a pilotless aerial torpedo that would explode at a pre-set time.

There are different types of drones are used for different purposes. At present there are four different types of drones, They are Multi-Rotor, Fixed-Wings, Single-Rotor, Hybrid VTOL. Multi-Rotor: multi-rotors are fundamentally very inefficient and require a lot of energy just to fight gravity and keep them in the air. With current battery technology they are limited to around 20-30 minutes when carrying a lightweight camera payload. Heavy-lift multi-rotors are capable of carrying more weight, but in exchange for much shorter flight times. Fixed-Wings: Fixed-wing drones (as opposed to 'rotary wing', i.e. helicopters) use a wing like a normal aeroplane to provide the lift rather than vertical lift rotors. Because of this they only need to use energy to move forward, not hold themselves up in the air, so are much more efficient. For this reason they are able to cover longer distances, map much larger areas, and loiter for long times monitoring their point of interest. In addition to the greater efficiency, it is also possible to use gas engines as their power source, and with the greater energy density of fuel many fixed-wing UAVs can stay aloft for 16 hours or more. Fixed-Wings fly 100m high. Single-Rotor: A single-rotor helicopter has the benefit of much greater efficiency over a multi-rotor, and also that they can be powered by a gas motor for even longer endurance. It is a general rule of aerodynamics that the larger the rotor blade is and the slower it spins, the more efficient it is. If you need to hover with a heavy payload (e.g. an aerial LIDAR laser scanner) or have a mixture of hovering with long endurance or fast forward flight, then a single-rotor heli is really your best bet. Hybrid VTOL: Merging the benefits of fixed-wing UAVs with the ability to hover is a new category of hybrids which can also take off and land vertically. There are only a handful of hybrid fixed-wing aircraft currently on the market, but you can expect this to be a much more popular option in the coming years as the technology is perfected.

Identifying the pilots of remotely-controlled drones is not easy. Drones are cheap, easy to fly, and widely available to consumers nowadays. Criminals take advantages of drone and performs attack. That's why police forces are turning to drone forensics teams whose jobs is to track down flyers of rogue drones. This drone criminals be identified by drone forensics team, only when a drone is found at a crime scene, Or when only fragments are found, Or when only a controller or phone is found. Investigators began to understand the enormous forensic resource that drones represent around the crime scene.

III. PROPOSED SYSTEM

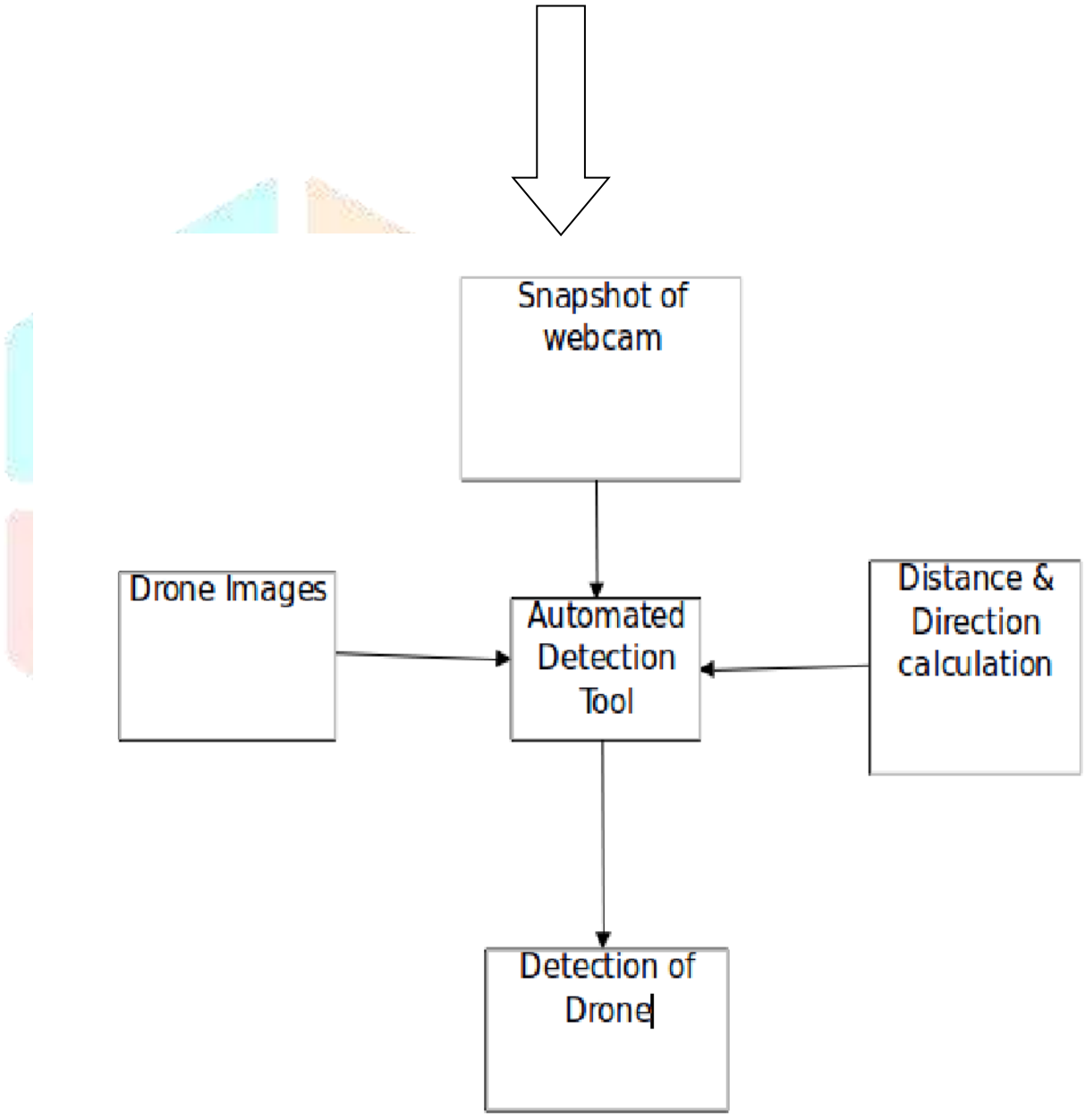
In this proposed system, we focus on identifying and classifying the drone using a machine learning algorithms like KNN and Templet Matching algorithm. We proposed the system "Identification and Classification of Drones Using KNN" we have identified the drone using an algorithm called Template Matching(a part OpenCV Algorithm) and classified different types of drones using an algorithm called KNN (K-Nearest Neighbors algorithm). In this proposed system, we were able to train the machine from the various attributes like length, width, height and curvature of different types drones to identify the type of drone that are entered in safety zone. We took csv data from the different types of drones to train the model. We majorly used two machine-learning libraries to solve the problem. The first one was cv2 from opencv, which is used for identification of drones using template matching, it takes two inputs one is actual image and second one is template, this template is compared by pixel by pixel in actual image. The second one numpy, which was used to calculation of values of the each and every pixel in screen and the values compared with the pixel values of the template for drone identification. The KNN algorithm is used for classifying the different types of drones, this algorithm from group of cluster based on the length, height, width and curvature of drone, each of one cluster indicates type of drones.

The basic approach of the supervised learning model is to learn the patterns and relationships in the data from the training set and then reproduce them for the test data. We used a dataset, this dataset is used for both training and testing purpose. The dataset is splited certain ratio, the highest volume of dataset is used as training data and rest of the volume of data is used as testing data. This dataset is a CSV file, that contains attributes like length, width, height and curvature of the drone including the label i.e., type drone like multi-rotor, single-rotor, fixed-wing and hybrid VTOL. We used all these features to train the machine on KNN model and classified different types of drones.

The distance of drone from the safety zone is calculated using distance calculation algorithm. This algorithm use to parameters, they are time taken by the Ultra sound wave, during first measure and time taken by the Ultra sound wave, during second measure. Based the values the algorithm calculate distance of the drone and also estimate the direction of drone.

IV. SYSTEM ARCHITECTURE

The details like web cam images and drone images are to be provided as input to the system, using corresponding user interface. The automated detection tool takes these two inputs and compares web cam images with the drone image template to identify the drone in the web cam image. The Distance and Direction calculation two values and calculates the distance of drone from the safety zone and direction of the drone. All these results are displayed on the user interface.



V. ALGORITHM

Template Matching:

Template Matching is a method for searching and finding the location of a template image in a larger image. OpenCV comes with a function cv.matchTemplate() for this purpose. It simply slides the template image over the input image (as in 2D convolution) and compares the template and patch of input image under the template image. Several comparison methods are implemented in OpenCV. It returns a grayscale image, where each pixel denotes how much does the neighbourhood of that pixel match with template.

1. Import library files. //cv2 and numpy
2. Read the main image // image captured by the web cam
3. Convert main image to grayscale.
4. Read the template image.
5. Store width and height of template in w and h.
6. Perform match operations using matchTemplate() method. Formula used

$$R(x,y) = \frac{\sum_{x',y'}(T(x',y') - I(x+x',y+y'))^2}{\sqrt{\sum_{x',y'} T(x',y')^2 \cdot \sum_{x',y'} I(x+x',y+y')^2}}$$

8. Specify a threshold.
9. Store the coordinates of matched area in a numpy array.
10. Draw a rectangle around the matched region.
11. Show the final image with the matched area.

KNN Classification:

K-Nearest Neighbors is one of the most basic yet essential classification algorithms in Machine Learning. It belongs to the supervised learning domain and finds intense application in pattern recognition, data mining and intrusion detection.

1. Calculate “d(x, xi)” i =1, 2, ….., n; where d denotes the Euclidean distance between the points.
2. Arrange the calculated n Euclidean distances in non-decreasing order.
3. Let k be a +ve integer, take the first k distances from this sorted list.
4. Find those k-points corresponding to these k-distances.
5. Let ki denotes the number of points belonging to the ith class among k points i.e. $k \geq 0$.
6. If ki >kj $\forall$ i $\neq$ j then put x in class i.

VI. CONCLUSION

This “Identification and classification of Drone using KNN ” has presented an approach to the automated Identification of Drone Type using KNN classification. The project is very useful to the security officers, as they get immediate security alerts, when any drone enters the security zone. The project useful, as it provides security, to the lives and important properties, against the attacks of Drones. This project can be enhanced further by implementing it as a whole, using the needed hardware infrastructure. As of now, only the software components are implemented.

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