D.R.D.O‘S UAV FLEET CHALLENGE

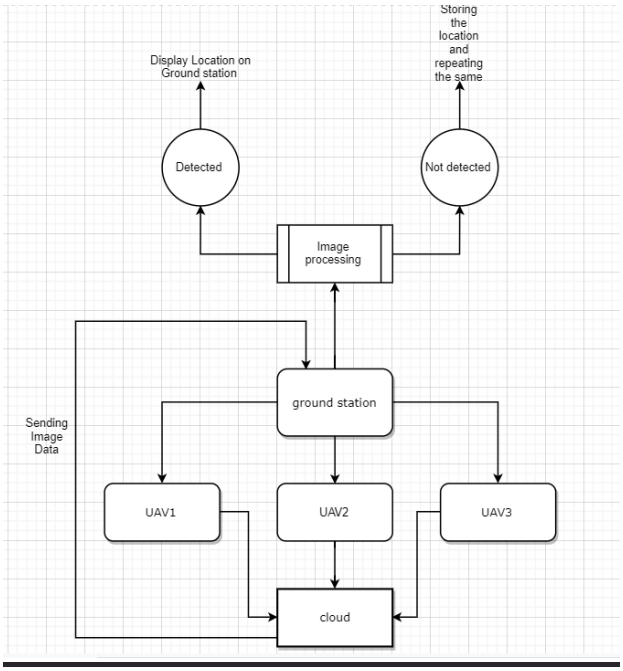
1) INTRODUCTION:

From the time of Independence, the Indian defence system has come a long way in terms of technology. We now have unmanned tanks, nuclear missile submarines, unmanned armed combat vehicles, and ASAT weapons which can destroy live satellites. Also, there are many tactics and strategies involved in the military. Camouflaging for example is an effective way to remain unseen.

In our project, we create a UAV Fleet and develop a new way to identify a target amongst a clutter of different objects spread randomly over a grassy land. We also communicate the location of the target using swarm technology. In this way, we are able to identify the specified target against a similar background.

Our project also has the potential to help the military. Here, we are identifying green objects on green background but the same technology can be used to identify camouflaged objects in a similar background. Using this, we can detec**t enemy soldiers during attack and also our own soldiers during rescue operations**.

2) METHODOLOGY:



The block diagram of the proposing approach is shown above. All UAV start from one point outside the arena and initial location coordinate are stored in the cloud. Ground station(laptop) is the centre of this swarm. All the command which are followed by the UAV coming from the ground station. All the UAVs are interconnected to each other through ground station here ground station is as a master and UAVs are as slaves.
UAVs are sent to the locations generated by ground station. The locations are generated depending upon the boundary location coordinates, as input to the ground station. Images taken by each UAV are sent to cloud. Rom cloud images are sent to ground station for pre-processing of images. Detected object locations are displayed on provided map.

UAV:
UAV is consisting of Raspi and Flight controller. Raspi is connected to flight controller through MAV link. RPI is taking coordinates from ground station and giving commands to flight controller.

Swarm Optimisation:

1.UAV movements:

The UAVs are planned to move independently of each other such that their paths never collide. The way this can be achieved, is such that, the entire field is firstly divided into a set of circular regions called nodes. These nodes represent the area of independent surveillance of each UAV where the possibility of finding the object is independent of the overlapped region between two nodes. Now since the field is divided into nodes traversing the nodes in minimum possible time would be the goal. After a series of trial and error it was found that the optimum strategy among the simplest ones is to divide the array of nodes into n radial angular regions, where n denotes the number of drones used. If the number of drones used is 3, then each drone would traverse 120 degrees of angular region each. The traversal in the region would be normal. From one node to another, like in the case of a DFS algorithm to simplify the cases.

2.Communication:

The communication between drones is not required as the region of surveillance of each drone is independent of each other. But there is a central server where all the algorithms for ML resides and which is used to detect whether the surveyed object is a box or not. Therefore, there is a need to communicate continuously between the drones and the server. This can be achieve using a publisher-subscriber model where the drones would be the client while the central server would be the broker. The client would publish to the broker the image of the surveyed region, while at the same time getting the data of the object detected result.

Detection of Cubes:

1.Pre-processing of an image captured by the Camera:

Firstly, we convolve the image with a Sobel Matrix, which identifies edges present in the image. The Sobel edge detection operation is capable of detecting very minute transitions in colour as an edge. This gives us a map of any colour transitions in the image.

We also parallely convolve the image with a Canny edge detector, which is not so sensitive to subtle changes in colour in the image. As a result, only the major edges will get highlighted. We can apply a Gaussian filter to smoothen the Canny image and then we can take a linear combination of the sobel(converted to one channel) and Canny image to identify the regions of subtle colour changes. The final output image is the preprocessed image with the green box in green background predominantly highlighted.

2.Object Detection:

We then use Object Detection algorithms to detect the object. The algorithm which we intend to use is YOLO(You Only Look Once). We intend to modify the algorithm to give us a True if a cube is located in a frame, or a False if it is not, provided it is sure of either of the results. If it is unsure of either of the results, it will raise a flag, which will then cause the drone to examine the object more closely to affirm it as a cube or not.

3) PRIMARILY WORK:

- A UAV drone system is designed, that was operating using flight controller.
- Open field test flight is initiated through remote.
- Connection between RPI and flight controller is established.
- Drone is moving to a given point autonomously.
- Object detection part has been over.

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