**PROJECT REPORT**

(Project Term June-December 2021)

**Recognition of Unmanned Vehicles (UMV) and Drones**

Submitted by

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**INT 246**

**(B. Tech CSE)**

Under the Guidance of

**Dr. Sagar Pande**

# School of Computer Science and Engineering

**LOVELY PROFESSIONAL UNIVERSITY**

**PHAGWARA, PUNJAB**



**DECLARATION**

We hereby declare that the project work entitled Recognition of Unmanned Vehicles (UMV) and Drones is an authentic record of our own work carried out as requirements of Project for the award of B. Tech degree in Computer Science and Engineering from Lovely Professional University, Phagwara, under the guidance of Sagar Pande, during August to November 2021. All the information furnished in this project report is based on our own intensive work and is genuine.

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Date: 20-11-2021

**CERTIFICATE**

This is to certify that the declaration statement made by this student is correct to the best of my knowledge and belief. They have completed this Project under my guidance and supervision. The present work is the result of their original investigation, effort, and study. No part of the work has ever been submitted for any other degree at any University. The Project is fit for the submission and partial fulfillment of the conditions for the award of B. Tech degree in Computer Science and Engineering from Lovely Professional University, Phagwara.

**Name of the Mentor:** Dr.Sagar Pande

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# ACKNOWLEDGEMENT

*I am overwhelmed in all humbleness and gratefulness to acknowledge my depth to all those who have helped me to put these ideas, well above the level of simplicity and into something concrete.*

*I would like to express my special thanks of gratitude to my teacher DR. SAGAR PANDE who gave me the golden opportunity to do this wonderful project on the topic* ***Recognition of Unmanned Vehicles (UMV) and Drones***

*, which also helped me in doing a lot of Research and i came to know about so many new things. I am really thankful to them.*

*Any attempt at any level can ‘t be satisfactorily completed without the support and guidance of MY parents and friends.*

*I would like to thank my Friends who helped me a lot in gathering different information, collecting data and guiding me from time to time in making this project, they gave me different ideas in making this project unique*

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**1. INTRODUCTION**

Despite attracting a wide attention in diverse civil and commercial applications, Unmanned Air Vehicles (UAVs - also known as drones) undoubtedly pose a number of threats to airspace safety that may endanger people and property. While such threats can be highly diverse in terms of the attackers’ intentions and sophistication, ranging from pilot unskillfulness to deliberate attacks, they all can produce severe disruption. Their frequency is also on the increase: in the first few months of the year 2019, for example, various airports in the USA, UK, Ireland, and UAE have experienced major disturbance of operation following drone sightings. Classic risk theory tells us that hazards whose probability is high and whose consequences are severe generate huge risks (risk assessment = probability × impact). Flight authorities worldwide are working hard on reducing the probability aspect of the risk equation by regulating drone operation. Regulations may discourage careless or unskilled drone operation, but cannot prevent criminal or terroristic attacks. To be effective, they must be supported by technologies enabling i- drone detection, classification, and tracking. In addition to these technologies which essentially address uncooperative drones, friendly UAVs should have onboard preventive technologies to support safe operation such as sense avoid, geofencing, parachuting systems, as well as mechanisms against different attacks such as jamming or hijacking of the control signal.

**1.1.** **Recognition of Unmanned Vehicles (UMV) and Drone**

A Recognition of UMV and Drone is developed to demonstrate the application of the proposed method. The system follows the object-detection ***approach,*** and it consists of two stages, namely, training and recognition stages. Training stage computes the representational bases for images in the domain of interest (that is reference images) and converts them into training image representations. The training image representations of each image are stored in the library. Using the representational bases recognition stage translates the testing image into probe image representation. Testing image is then matched with reference images which are stored in the library to identify the face image.

**1.1.1.** **DATABASES USED**

I have prepared my own database which has consists of more than 1,000 UAV images of more than 50 models. The diversity of my database is related to model, size, and color. Images are acquired from different websites.

### **1.1.2. FRAMEWORK FOR**

### Face recognition is a technique that takes the image of a person (query image) and compares it with the previously recorded images in the database. This is done by comparing the invariant features obtained from the techniques that capture the representative variability of the faces or the structure, the shape, and the face attributes like distance between the eye centers and nose, upper outlines of the eyes, width of eyebrows, etc. Face recognition has the benefit of being a passive, non-intrusive system to verify personal identity in a natural and friendly way. The main benefit of this technique over other biometric approaches is that the face images can be taken from a distance even without the knowledge of the individual being observed as might be required in identifying the presence of the criminals in a bank or government offices, etc.

### **1.1.3. APPLICATIONS**

It has become one of the most active research areas especially in recent years as it has a variety of wide applications in the areas:

* Airport security
* Access control
* Human-computer intelligent interaction
* Digital libraries and information security

**1.1.4. CHALLENGES**

The challenges associated with UMV recognition can be attributed to the following factors:

* Presence or absence of structural UMV features: Structural features such as wings, body, and case may or may not be present and there is a great deal of variability among these components including shape, color, and size.
* Pose: The images of a UMV vary due to the relative camera-face pose (frontal, tilted, profile, upside down).
* Occlusion: UMV may be partially occluded by other objects. For an example, in an image with a group of objects, some UMV may partially occlude other object (UMV identification).
* Image orientation: UMV images directly vary for different rotations about the camera’s optical axis.
* Imaging conditions: When the image is formed, factors such as lightning and camera characteristics affect the appearance of a UMV.

**1.1.5. WHY USE THE OBJECT DETECTION FOR RECOGNITION OF UMV?**

### The exponentially increasing public accessibility of drones has been posing a great threat to the general security and confidentiality. The drone sales have been increasing consistently each year and they are expected to be much more widespread in the future. To highlight the importance of the subject, several incidents with drones in recent years can be given as examples : the alarming security incident around the White House , mysterious appearance of multiple drones for several days around nuclear power plants in France, horrific near collision of an airliner and a drone near LAX airport and the drone intrusion by an opposition party during a campaign of German chancellor, which has alerted the security officials. Drones are also perfect tools for the illegal smugglers thanks to their low visibility. All these threats adds up for the introduction of object detection with help of optical devices in the field of recognition of UMV.

**SOURCE CODE**

**Training Test Code:**

**Connect google drive**

In [ ]:

*# Check if NVIDIA GPU is enabled*

**!**nvidia-smi

**1) Clone the Darknet**

In [ ]:

**!**git clone https://github.com/AlexeyAB/darknet

**2) Compile Darknet using Nvidia GPU**

In [ ]:

*# change makefile to have GPU and OPENCV enabled*

**%cd** darknet

**!**sed -i 's/OPENCV=0/OPENCV=1/' Makefile

**!**sed -i 's/GPU=0/GPU=1/' Makefile

**!**sed -i 's/CUDNN=0/CUDNN=1/' Makefile

**!**make

**3) Configure Darknet network for training YOLO V3**

In [ ]:

**!**cp cfg/yolov3.cfg cfg/yolov3\_training.cfg

In [ ]:

**!**sed -i 's/batch=1/batch=64/' cfg/yolov3\_training.cfg

**!**sed -i 's/subdivisions=1/subdivisions=16/' cfg/yolov3\_training.cfg

**!**sed -i 's/max\_batches = 500200/max\_batches = 4000/' cfg/yolov3\_training.cfg

**!**sed -i '610 s@classes=80@classes=1@' cfg/yolov3\_training.cfg

**!**sed -i '696 s@classes=80@classes=1@' cfg/yolov3\_training.cfg

**!**sed -i '783 s@classes=80@classes=1@' cfg/yolov3\_training.cfg

**!**sed -i '603 s@filters=255@filters=18@' cfg/yolov3\_training.cfg

**!**sed -i '689 s@filters=255@filters=18@' cfg/yolov3\_training.cfg

**!**sed -i '776 s@filters=255@filters=18@' cfg/yolov3\_training.cfg

In [ ]:

*# Create folder on google drive so that we can save there the weights*

**!**mkdir "/mydrive/yolov3"

In [ ]:

**!**echo "UAV" > data/obj.names

**!**echo -e 'classes= 1\ntrain = data/train.txt\nvalid = data/test.txt\nnames = data/obj.names\nbackup = /mydrive/yolov3' > data/obj.data

**!**mkdir data/obj

In [ ]:

*# Download weights darknet model 53*

**!**wget https://pjreddie.com/media/files/darknet53.conv.74

**4) Extract Images**

The images need to be inside a zip archive called "images.zip" and they need to be inside the folder "yolov3" on Google Drive

In [ ]:

**!**unzip /mydrive/yolov3/images.zip -d data/obj

In [ ]:

*# We're going to convert the class index on the .txt files. As we're working with only one class, it's supposed to be class 0.*

*# If the index is different from 0 then we're going to change it.*

**import** glob

**import** os

**import** re

txt\_file\_paths **=** glob**.**glob(r"data/obj/\*.txt")

**for** i, file\_path **in** enumerate(txt\_file\_paths):

*# get image size*

**with** open(file\_path, "r") **as** f\_o:

lines **=** f\_o**.**readlines()

text\_converted **=** []

**for** line **in** lines:

print(line)

numbers **=** re**.**findall("[0-9.]+", line)

print(numbers)

**if** numbers:

*# Define coordinates*

text **=** "{} {} {} {} {}"**.**format(0, numbers[1], numbers[2], numbers[3], numbers[4])

text\_converted**.**append(text)

print(i, file\_path)

print(text)

*# Write file*

**with** open(file\_path, 'w') **as** fp:

**for** item **in** text\_converted:

fp**.**writelines("%s\n" **%** item)

In [ ]:

**import** glob

images\_list **=** glob**.**glob("data/obj/\*.jpg")

print(images\_list)

In [ ]:

*#Create training.txt file*

file **=** open("data/train.txt", "w")

file**.**write("\n"**.**join(images\_list))

file**.**close()

**6) Start the training**

In [ ]:

*# Start the training*

**!**./darknet detector train data/obj.data cfg/yolov3\_training.cfg darknet53.conv.74 -dont\_show

**UMV Detection Code:**

|  |
| --- |
|  |
|  | Import cv2  import numpy as np |
|  | import glob |
|  | import random |
|  |  |
|  |  |
|  | # Load Yolo |
|  | net = cv2.dnn.readNet("yolov3\_training\_last.weights", "yolov3\_testing.cfg") |
|  |  |
|  | # Name custom object |
|  | classes = ["UAV"] |
|  |  |
|  | # Images path |
|  | images\_path = glob.glob(r"/Users/arjunbhardwaj/Downloads/archive/drone\_dataset\_yolo/dataset\_txt/\*0.jpg") |
|  |  |
|  |  |
|  |  |
|  | layer\_names = net.getLayerNames() |
|  | output\_layers = [layer\_names[i - 1] for i in net.getUnconnectedOutLayers()] |
|  | colors = np.random.uniform(0, 255, size=(len(classes), 3)) |
|  |  |
|  | # Insert here the path of your images |
|  | random.shuffle(images\_path) |
|  | # loop through all the images |
|  | for img\_path in images\_path: |
|  | # Loading image |
|  | img = cv2.imread(img\_path) |
|  | img = cv2.resize(img, None, fx=0.4, fy=0.4) |
|  | height, width, channels = img.shape |
|  |  |
|  | # Detecting objects |
|  | blob = cv2.dnn.blobFromImage(img, 0.00392, (416, 416), (0, 0, 0), True, crop=False) |
|  |  |
|  | net.setInput(blob) |
|  | outs = net.forward(output\_layers) |
|  |  |
|  | # Showing informations on the screen |
|  | class\_ids = [] |
|  | confidences = [] |
|  | boxes = [] |
|  | for out in outs: |
|  | for detection in out: |
|  | scores = detection[5:] |
|  | class\_id = np.argmax(scores) |
|  | confidence = scores[class\_id] |
|  | if confidence > 0.3: |
|  | # Object detected |
|  | print(class\_id) |
|  | center\_x = int(detection[0] \* width) |
|  | center\_y = int(detection[1] \* height) |
|  | w = int(detection[2] \* width) |
|  | h = int(detection[3] \* height) |
|  |  |
|  | # Rectangle coordinates |
|  | x = int(center\_x - w / 2) |
|  | y = int(center\_y - h / 2) |
|  |  |
|  | boxes.append([x, y, w, h]) |
|  | confidences.append(float(confidence)) |
|  | class\_ids.append(class\_id) |
|  |  |
|  | indexes = cv2.dnn.NMSBoxes(boxes, confidences, 0.5, 0.4) |
|  | print(indexes) |
|  | font = cv2.FONT\_HERSHEY\_PLAIN |
|  | for i in range(len(boxes)): |
|  | if i in indexes: |
|  | x, y, w, h = boxes[i] |
|  | label = str(classes[class\_ids[i]]) |
|  | color = colors[class\_ids[i]] |
|  | cv2.rectangle(img, (x, y), (x + w, y + h), color, 2) |
|  | cv2.putText(img, label, (x, y + 30), font, 3, color, 2) |
|  |  |
|  |  |
|  | cv2.imshow("Image", img) |
|  | key = cv2.waitKey(0) |
|  |  |
|  | cv2.destroyAllWindows() |

**CONCLUSION**

### In their “Clarity From Above” report, there is a prediction that the global market for commercial drones will grow to more than 127 billion dollars with key applications in infrastructure, agriculture, transport, security, media, insurance, telecommunication, and mining . However, drone operation is associated with high risk for people and assets. Authorities are working hard toward regulations for drone operation so that less disruptions are recorded. In some cases, these regulations are also supported by ICT solutions to improve the authorization and notification process such as the Low Altitude Authorization and Notification Capability (LAANC) by the Aviation Administration (FAA)].

### Rules and supportive technologies are good for those who follow them but not for careless or malicious users. Systems which are able to keep overview of what is going on are required in the low-altitude airspace, to run a continuous risk assessment, and to interdict in the case of violation. A major task towards this goal is being able to detect, classify, and identify drones in the sky. The expected growth in the drone market and the associated increase in the number of drones in the sky will challenge this task and question the efficiency of human-centered solutions. Machine learning can play a key role in this respect as was shown in this review. The digital processing of different modalities has made machine learning applicable in every detection system as long as the system operator is ready to pay attention to data.

### Issues related to the quantity and quality of data in machine learning are well known. But in the case of drone detection and classification, these issues can be described as urgent due to the high business pressure on the one hand and the high risk of operation on the other. Collaborative efforts to build publicly available datasets are indispensable to help researchers and developers build robust classification models for drones based on all modalities.

### The risk associated with drone operation strongly depends on the drone location and how far from critical areas it flies. Therefore, ranging should actually be a very important objective. However, as shown in the review researchers have focused on the detection performance and–in the best case–information was given about the drone distance at which the drone was detected. No study was presented which investigated the classification performance as a function of drone distance not to speak of determining the range using regression models. This can be a very interesting research area in the future.

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